

# INTERFACE™



MICROCOMPUTING FOR HOME AND SMALL BUSINESS VOL. 2, ISSUE 6, MAY 1977 \$1.50

**Computrac 2000**  
**Help Your Computer**  
**Understand Your Voice**  
**Game of Life**

**THE FLOPPY ROM™**  
**INSIDE**

# CT-64 TERMINAL SYSTEM



- \* 64 OR 32 CHARACTERS PER LINE
- \* UPPER AND lower case LETTERS
- \* FULL 8 BIT MEMORY
- \* 128 CHARACTER ASCII SET
- \* 110/220 Volt 50-60 Hz POWER SUPPLY
- \* SCROLLING OR PAGE MODE OPERATION
- \* CONTROL CHARACTER DECODING—32 COMBINATION
- \* PRINTS CONTROL CHARACTERS
- \* USABLE WITH ANY 8 BIT ASCII COMPUTER
- \* REVERSED BACKGROUND — **HIGHLIGHTING**

**COMPLETE WITH —** Chassis and cover, cursor control, 110-1200 Baud serial interface and keyboard. Optional monitor shown in photo available.

Now you can buy it. The terminal that has all the features that people have been asking us to include. The CT-64 has all the functions that you could want in a terminal and they may be operated by either switches, or through a software program.

All cursor movements, home-up and erase, erase to end of line, erase to end of frame, read on, read off, cursor on, cursor off, screen reversal, scroll, no scroll, solid cursor, blinking cursor, page selection and a beeper to warn you of end of page; all are provided for your use in the CT-64.

You may also switch from upper case only teletype style operation to upper-lower case typewriter style operation. You can reverse the field on individual words to highlight them, or you can reverse the whole screen.

CT-64 is complete with keyboard, power supply serial interface and case. A matching 9 inch monitor with coordinated covers is also available to make a complete system.

CT-64 Terminal Kit	<b>\$325.00</b>
MM-1 Monitor (assembled)	<b>\$175.00</b>



219 W. Rhapsody

San Antonio, Texas 78216

You are right, it's just what I have been asking for.

- |  |  |
|--|--|
| <input type="checkbox"/> Enclose is \$325.00 for the CT-64 | <input type="checkbox"/> Send Data     |
| <input type="checkbox"/> Send the MM-1 monitor too.        | <input type="checkbox"/> # _____       |
| <input type="checkbox"/> or BAC _____                      | <input type="checkbox"/> Ex Date _____ |
| <input type="checkbox"/> or MC _____                       |  |

NAME \_\_\_\_\_

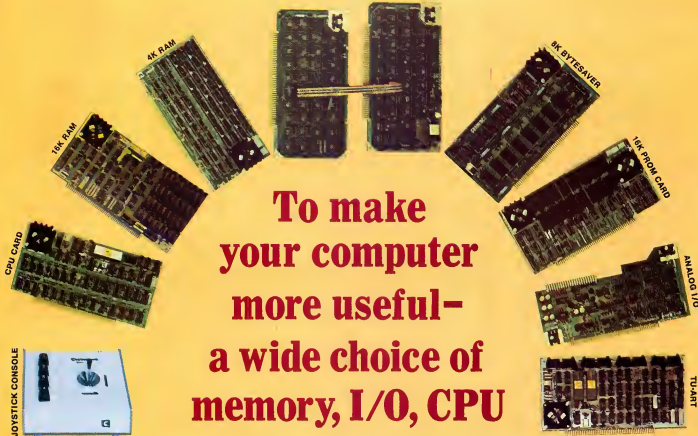
ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_

ZIP \_\_\_\_\_

Southwest Technical Products Corp.  
219 W. Rhapsody, San Antonio, Texas 78216



## To make your computer more useful— a wide choice of memory, I/O, CPU

Your computer's usefulness depends on the capability of its CPU, memories, and I/O interfaces, right?

So here's a broad line of truly useful computer products that lets you do interesting things with your Cromemco Z-1 and Z-2 computers. And with your S-100-compatible Altairs and IMSAIs, too.

### CPU

- **Z-80 MICROPROCESSOR CARD.** The most advanced  $\mu$ P card available. Forms the heart of our Z-1 and Z-2 systems. Also a direct replacement for Altair/IMSAI CPUs. Has 4-MHz clock rate and the power of the Z-80  $\mu$ P chip. Kit (Model ZPU-K): \$295. Assembled (Model ZPU-W): \$395.

### MEMORIES

- **16K RAM.** The fastest available. Also has bank-select feature. Kit (Model 16KZ-K): \$495. Assembled (Model 16KZ-W): \$795.
- **4K RAM.** Bank-select allows expansion to 8 banks of 64K bytes each. Kit (Model 4KZ-K): \$195. Assembled (Model 4KZ-W): \$295.
- **THE BYTESAVER**—an 8K capacity PROM card with integral pro-

grammer. Uses high-speed 2708 erasable PROMs. A must for all computers. Will load 8K BASIC into RAM in less than a second. Kit (Model BSK-0): \$145. Assembled (Model BSW-0): \$245.

- **16K CAPACITY PROM CARD.** Capacity for up to 16K of high-speed 2708 erasable PROM. Kit (Model 16KPR-K): \$145. Assembled (Model 16KPR-W): \$245.

### I/O INTERFACES

- **FAST 7-CHANNEL DIGITAL ANALOG I/O.** Extremely useful board with 7 A/D channels and 7 D/A channels. Also one 8-bit parallel I/O channel. Kit (Model D + 7A-K): \$145. Assembled (Model D + 7A-W): \$245.
- **TV DAZZLER.** Color graphics interface. Lets you use color TV as full-color graphics terminal. Kit (Model CGI-K): \$215. Assembled (Model CGI-W): \$350.
- **DIGITAL INTERFACE (OUR NEW TV-ART).** Interfaces with teletype, CRT terminals, line printers, etc. Has not one but two serial I/O ports and two 8-bit parallel I/O ports as well as 10 on-board interval timers. Kit

(Model TRT-K): \$195. Assembled (Model TRT-W): \$295.

- **JOYSTICK.** A console that lets you input physical position data with above Model D + 7 A/D card. For games, process control, etc. Contains speaker for sound effects. Kit (Model JS-1-K): \$65. Assembled (Model JS-1-W): \$95.

### PROFESSIONAL QUALITY

You get first-class quality with Cromemco.

Here are actual quotes from articles by independent experts: "The Cromemco boards are absolutely beautiful" . . . "The BYTESAVER is tremendous" . . . "Construction of Cromemco I/O and joystick are outstanding" . . . "Cromemco peripherals ran with no trouble whatsoever."

Everyone agrees. Cromemco is tops.

### STORES/MAIL

So count on Cromemco. Look into these Cromemco products at your store. Or order by mail from the factory.

We wish you pleasure and success with your computer.



## Cromemco

incorporated

Specialists in computers and peripherals

2432 CHARLESTON RD., MOUNTAIN VIEW, CA 94043 • (415) 964-7400

# INTERFACE<sup>TM</sup>

## MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

### FEATURES

- COMPUTRAC 2000** ..... 16  
AN EXCITING APPLICATION OF A  
MICROPROCESSOR IN STEREO EQUIPMENT  
DESIGN *by Robert Cheeseboro,  
Designer of the System*

- THE FLOPPY-ROM<sup>TM</sup> EXPERIMENT** ..... 28  
THE BIRTH OF AN IDEA THAT GREW TO  
SUCCESS BY THE HELP OF THE INDUSTRY  
IT SERVES *by Robert S. Jones, Publisher*

- THE SEARCH FOR A GOOD, RANDOM ACCESS,  
RECORD CUTTING JUKE BOX** ..... 29  
FROM IDEA TO REALITY: SIX MONTHS OF  
PLANNING AND HARD WORK *by William Blomgren*

- ROBERT UITERWYK'S 4K BASIC INTERPRETER PROGRAM** ..... 40  
HOW TO LOAD THE FLOPPY-ROM DATA  
INTO YOUR 6800 MICROCOMPUTER *by William W. Turner*

- HELP YOUR COMPUTER UNDERSTAND YOUR VOICE** ..... 56  
TALKING COMPUTERS ARE NICE;  
LISTENING COMPUTERS ARE NICER *by Owen F. Thomas*

### PRODUCT PREVIEWS

- MULTI-TYME<sup>TM</sup>** ..... 68  
*by Michael di Meo*

### HARDWARE FEATURES

- HARDWARE REPORT** ..... 84  
*by Roger Edelson, Hardware Editor*

- CARD OF THE MONTH: POLY I/O IDEABOARD** ..... 95  
*by Roger Edelson, Hardware Editor*

### SOFTWARE FEATURES

- SOFTWARE EDITORIAL** ..... 103  
*by Robert A. Stevens, Software Editor*

- CONVERT MOTOROLA 6800 HEX FORMAT TO  
INTEL FORMAT** ..... 109  
*by Floyd Nordin*

- USER TTY HANDLER FOR THE Z-80 DEVELOPMENT SYSTEM** ..... 111  
*by Richard E. Maly*

- NUMBER BASE CONVERSION ROUTINE** ..... 114  
*by John W. Swain*

- SC/MP SEIKO PRINTER INTERFACE AND PROGRAM -  
SSEIKOPP** ..... 118  
*by Philip Roybal*

- CHECKBOOK BALANCER PROGRAM - JHCBBP** ..... 126  
*by Jim Huffman*

- LOGAN ... A LOGIC CIRCUIT ANALYSIS PROGRAM** ..... 128  
*by Robert J. Bishop*

- APPLE STAR-TREK** ..... 132  
*by Robert J. Bishop*

- JOHN CONWAY'S GAME OF LIFE** ..... 135  
*by Alan R. Miller*



### COVER STORY

"Hidden jewels, abstract sculptures of great beauty, harmonious blendings of color schemes." Do these words describe the contents of a pharaonic tomb? They could, but in this case the eye of the present looks not upon the past's surviving glory, rather upon the present's ubiquitous artifact, a memory board.

The balanced beauty of the assembled board exemplifies the dictum that good engineering is good art. We were happy to find this specimen to use for this month's cover. The board, an LSI-II, is from Digital Equipment Corporation who also supplied the photography. Watch for an in-depth story on this computer system in a future issue.

Advertising Index	144
Book Review	83
FIFO Flea Market	142
From the Fountainhead	12
Hardware Section	84
Interfacial	4
Letters to the Editor	140
Micro-Market	141
Product Previews	68
Software Section	103
Update and Calendar	6

INTERFACE AGE Magazine, published monthly by McPheters, Wolfe & Jones, 13913 Artesia Blvd., Cerritos, Calif. 90701. Subscription rates: U.S. \$10.00, Canada/Mexico \$12.00, all other countries \$18.00. Opinions expressed in by-lined articles do not necessarily reflect the opinion of this magazine or the publisher. Mention of products by trade name in editorial material or advertisements contained herein in no way constitutes an endorsement of the product or products by this magazine or the publisher.

INTERFACE AGE Magazine COPYRIGHT © May 1977 by McPheters, Wolfe & Jones. ALL RIGHTS RESERVED. Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Nancy Jones, Rights and Permissions, McPheters, Wolfe & Jones, 13913 Artesia Blvd., Cerritos, Calif. 90701.

POSTMASTER: Please send change of address form 3579 and undelivered copies to INTERFACE AGE Magazine, 13913 Artesia Blvd., Cerritos, Calif. 90701. Second-class postage paid at Artesia, California 90701 and at additional mailing offices.



# The Digital Group adds character(s).



## 64, to be exact.

The Digital Group's computer systems have a lot of character already. Just one quick look at any of our products in their unique custom cabinets confirms that. But we believe it never hurts to add a bit more.

So, the Digital Group has added character in a big way to give an added dimension to the operation of our video-based computer systems. We are pleased to announce our new TV Readout with a 64-character line. It will give your system a great deal more capability. Give it more character, if you will.

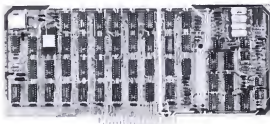
Here are the specifics on the Digital Group TV Readout and Audio Cassette Interface:

### 1024 Character TV Readout

- 64 characters horizontal by 16 lines
- 7x9 character matrix (effectively 7x12 due to character shifting)
- 1K on-board RAM for buffer storage—requires no main memory—completely independent
- 128 character ASCII
  - Upper case alpha
  - Lower case alpha with base line extenders (g, j, p, y)
  - Numbers and extended math symbols
  - Greek alphabet
- Software driven cursor—forward and backward
- Compatible with most microprocessors; Interfaces with 18-bit parallel output port
- Timebase may be driven with an external timebase (may be synchronized to TV camera, TV set, etc.)
- Readout timebase available at connector (can be used for graphic driver, etc.)
- White characters on black, and/or black on white; software selectable
- Plugs into standard dual 22-pin TVC connector on Digital Group Systems

### Improved Audio Cassette Interface:

- Reliable FSK recording technique
- Uses standard unmodified audio cassette recorder



(100 characters/second)—loads  
16K in 3 minutes

- Write cassette system uses a digitally synthesized frequency shift system, derived from TV system's master crystal oscillator
- Read cassette system easily aligned using the write system as an alignment aid.
- Runs at 1100 baud

### 512 TVC to 1024 TVC Upgrade Kit:

As always, when the Digital Group extends the capabilities of our systems, it doesn't mean obsolescence for any products. We are offering an upgrade kit for present Digital Group system owners who wish to go to the longer line length. This kit uses most of the IC's from our TVC-F readout. No unsoldering is required; all new sockets, capacitors, resistors, PC board and other necessary parts are supplied.

### Prices:

TVC-64—Full 64-character TV Readout & Audio Cassette Interface:

Kit — \$140      Assembled — \$205

TVC-64UPG—Upgrade kit from TVC-F:

Kit — \$65

If you already own a Digital Group system, our 64-character line will definitely enhance its operation. If you're just looking, you might want to keep in mind that the Digital Group has a lot of characters.

Write or call now for details on our new 64-character TV readout and all our other exciting products.

the digital group

box 6528 denver, colorado 80206 (303) 777-7133

# INTERFACIAL



This month INTERFACE AGE sets up a publishing milestone. Between pages 32 and 33 is a removable vinyl record which can be played on a standard record player and transferred to cassette or directly through the cassette Interface into your computer.

Over six months went into the development of the process required to produce this record. The article in which the record is embedded, PLATTER BASIC by William Blomgren, describes how the "floppy-ROM" was produced, while in the following article by William Turner the theme segues into describing the implementation and language features of ROBERT UITERWYK's 4K 6800 BASIC.

Be sure to respond to the survey questions appearing on page 29 requested by the publisher.

If you are both a microcomputer and a music buff, Bob Cheeseboro has designed just the equipment for you, a microprocessor-controlled turntable.

Listening people and talking computers are numerous, but listening computers and computer-intelligible people are still rare. Owen Thomas in HELP YOUR COMPUTER UNDERSTAND YOUR VOICE explains what problems are encountered in that conversation mode.

In any mode of operation your computer relies upon ICs to accomplish its task. Roger Edelson continues his efforts to inform you in HARDWARE REPORT of the best hardware available.

Bob Stevens once more offers a useful and entertaining selection of software which he describes in his own editorial heading the SOFTWARE SECTION.

...

Readers, do you really agree with us all that much that you have no objections to voice nor suggestions to offer? Are we really that impeccable? Publishing is somewhat like the political process in that the publisher becomes aware that the

magazine has fallen from favor when a cancellation arrives or a renewal is not made; the politician becomes aware the night of the vote tally. In both cases information flows most of the time in a one-way direction to the public and in most cases letters supply the feedback necessary for improvement.

Tell us what we do wrong — besides planting a *Printer's Devil* in a lead statement on page 16 of the April Issue. Give our authors a sound rebuttal now and then; it is good for them and even better for us. Anyway, we want to hear from you.

Speaking of Imps and devils, did you catch on that Roger Garrett's Remotoid was built in A.D. 1999?

...

June will feature a BIONICS special. This branch of technology is new and at times controversial, as in the case of Robotics. We feel, however, that of all the aspects of the electronic revolution, this is the most humane endeavor. As everyone now knows from the television series, bionics is the art of building operating body members for those who have had the misfortune of losing what Nature bequeathed.

Sometimes the fundamentalists feel uncomfortable with these arts and express their discomfiture through remarks such as "playing God" or "If God meant you to have a second limb, you'd grow one." It is to wonder if that same person were 22 years of age and a double amputee, would he reject Science's offer to put him back into shoesoles that tread stairs and curbs, to wear a new suit without folding back portions of it, to use the normal stalls in the men's room and to assist his infant son in taking his first steps.

These examples are not taken from an editor's fantasy, rather from documentable case histories. Bionics is truly a tool for the restoration of depleted dignity and destroyed hopes. It is Science in its most sublime assignment.

—L.F.S.

## INTERFACE AGE MAGAZINE

13913 Artesia Boulevard  
Cerritos, CA 90701  
(213) 926-6629

---

**PUBLISHER &  
EDITOR-IN-CHIEF**  
ROBERT S. JONES

---

**ASSOCIATE EDITOR**  
LINDA FOLKARD-STENGEL

---

**GENERAL MANAGER**  
NANCY A. JONES

---

**ASSISTANT MANAGER**  
EVA YAKA

---

**NORTHWESTERN  
REGIONAL EDITOR**  
ADAM OSBORNE PhD

---

**EDITORIAL CO-ORDINATOR**  
WILLIAM SEVEDGE

---

**HARDWARE EDITOR**  
ROGER EDELSON

---

**SOFTWARE EDITOR**  
ROBERT STEVENS

---

**CONSULTING EDITOR**  
JANE HILL ALDEN

---

**PRODUCTION LAYOUT**  
MIKE ANTICH

---

**ART**  
CHARLYNE LEVANDOWSKI

---

**SUBSCRIPTION CIRCULATION**  
JO ANN FERGUSON

---

**Editorial Correspondence**  
Direct all correspondence to the appropriate editor at: INTERFACE AGE magazine, P.O. Box 1234, Cerritos, CA 90701. Editorial contributions must be accompanied by return postage and will be handled with reasonable care, however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

---

**NATIONAL SALES MANAGER**  
BRUCE BERKEY

---

**ADVERTISING—Representative**  
STEVE RICHARDS  
ZACH BOVINETTE

---

**Advertising Inquiries**  
Direct all advertising inquiries to: Advertising Department, INTERFACE AGE magazine, 61 South Lake Avenue, P.O. Box 4586, Pasadena, CA 91106. (213) 795-7002.

---

**RETAIL CIRCULATION**  
ZACH BOVINETTE

---

**wpa**

# PRIME RADIX

ANNOUNCES  
THE

# 64K™

**WE DO IT WITH MIRRORS!**  
(and some very sophisticated state-of-the-art memory design)

## 65,536 BYTES

Your dream can be a reality with the Prime Radix Corporation's 64K™ memory system at a very cost-effective price. And because it is a standalone memory system, you've got the advantage of greater flexibility not ordinarily available from add-in memory. Some of the features are:

- The 64K™ is fully buffered, presenting one TTL load to the memory bus.
- The 64K™ is digital group bus and ALTAIR™ bus compatible. **When ordering, you must specify the bus architecture.** A plugcard and cable will be furnished for the particular bus architecture you specify.
- 64K™ is expandable to larger word lengths (16 bits; 24 bits; 32 bits; all organizations with or without parity). Other bus compatibilities will be available soon.
- The minimum complement of memory is 40K BYTES, with starting address locations at 0K, 8K, 16K, or 24K.

- The 64K™ comes assembled and tested with its own power supply, attractively housed in an aluminum cabinet, ready to plug into your system. With a choice of a freestanding cabinet or a 19" rack-mountable cabinet, 5" h x 18" w x 14" d.
- Pseudo-static operation: on board refresh clock-generator provides processor independent refresh with no wait states. The 300NS worst case access time enhances high speed operation.
- Power/fail detection circuitry and battery backup will provide non-volatile memory (batteries are optional at extra cost).

LIST PRICE IS AS FOLLOWS:

40K	48K	56K	64K
\$1490.00	\$1580.00	\$1670.00	\$1750.00

Delivery will be made in the same sequence as orders are received. Please allow 3 to 6 weeks for delivery. Mastercharge and BankAmericard are accepted.

• Prime Radix, Inc. • P.O. Box 11245 • Denver, CO 80211 • (303) 573-5942 or (303) 433-5630 •

**PRIME RADIX**  
COMPUTER SYNTHESIS

Print Name

Address

City

State

Zip

☐ DIGITAL GROUP BUS

☐ ALTAIR™ BUS

☐ 64K @ \$1750.00

☐ 56K @ \$1670.00

☐ 48K @ \$1580.00

☐ 40K @ \$1490.00

☐ Check or M.O. enclosed

☐ Charge BAC

☐ Charge MC

(Please No C.O.D.'s or P.O.'s)

Make checks or money orders payable to:

PRIME RADIX, INC.  
P.O. Box 11245  
Denver, Colorado 80211  
(303) 573-5942  
or 433-5630

Credit Card Number

4 Numbers Above Name (MC) Good Thru

Signature

# UPdate

## ACM — PACIFIC 77

"Exploring the Small Computer" is the theme of the conference which is expected to range in coverage from personal computing through small business applications and from computer parts and peripherals through bullet-proof software.

The conference will be held July 28-29, 1977 at LeBaron Hotel, San Jose, CA. For registration information contact the ASSOCIATION FOR COMPUTING, Box 60355, Sunnyvale, CA 94088 or General Chairman, Mr. Peter Szego, Ampex Corp., Redwood City, 415-367-3126. Deadline for paper submittal was April 1, but persons interested in submittal information, contact Dr. Robert M. McClure, Program Chairman, 14332 Macley Ct., Saratoga, CA 95070.

## NATIONAL COMPUTER CONFERENCE

More than 25,000 people are expected to gather in Dallas for a conference program of more than 100 sessions. This conference represents the year's largest display of computer hardware, software, systems and service combined with the first National Programming Contest and a series of professional seminars.

1977 National Computer Conference will take place in the Dallas Convention Center, June 13-16, 1977. Personal Computing headquarters for the 77NCC will be at Holiday Inn, Downtown Dallas. Low-cost housing is made available through Southern Methodist U. Travel packages and exhibiting information may be obtained through 77NCC, c/o AFIPS, 210 Summit Ave., Montvale, N.J. 07645 or call 201-391-9810.

## INTERNATIONAL SYMPOSIUM ON COMPUTER-AIDED SEISMIC ANALYSIS AND DISCRIMINATION

A two-day conference sponsored by the IEEE Computer Society will

be held at the Sheraton Inn, Falmouth, MA. The symposium will bring together scientists and engineers from the fields of geophysics, seismology, computers, signal processing and information sciences.

Advanced registration closes May 23. The \$30 registration fee includes a copy of the conference record, all coffee breaks and two lunches. Late registration is \$35. For further information on the symposium, write to Conference Chairman, Professor C. H. Chen, Elect. Engineering Dept., Southeastern Massachusetts U., N. Dartmouth, MA 02747.

## CALL FOR PAPERS

Original papers on novel and recent developments on all aspects of computer architecture are solicited for the Fifth Annual Symposium on Computer Architecture to be held April 3-5, 1978 in Palo Alto, CA.

The symposium is sponsored by the ACM and the IEEE Computer Society in co-operation with Stanford U. Manuscripts on systems architecture, new technologies, LSI architecture, I/O structures, memories, firmware, reliability and maintainability and power and packaging are requested. For submittal information contact Program Chairman, David Crockett, Hewlett-Packard, 11000 Wolfe Rd., Cupertino, CA 95014, 408-257-7000, ext. 2629.

## CAMPING WITH COMPUTERS

Four one-week programs in computer programming will be offered this summer at Rose-Hulman Institute of Technology, Terre Haute, Indiana. The program, known as Camp Retupmoc, is for boys about to enter their junior or senior years in high school; it consists of lectures on BASIC programming, films on computing, and talks by computer scientists in business and industry who are making novel applications of the computer.

Dates for the Camps are June

## BUY YOUR COMPCOLOR 8001 FROM THESE DEALERS.

<b>ARIZONA</b>		
Phoenix	Phoenix Byte Shop West 1265 N. 28th Dr.	(602) 942-7300
Tempe	Tempe Byte Shop East 813 N. Scottsdale Rd.	(602) 894-1129
Tucson	Byte Shop of Tucson 2812 E. Broadway	(602) 327-4579
<b>CALIFORNIA</b>		
Lawndale	Byte Shop of Lawndale 16508 Hawthorne Blvd.	(213) 371-2421
Orange	Computer Mart of Los Angeles 625 W. Katella, No. 10	(714) 633-1222
San Diego	The Computer Center 8205 Reardon Rd.	(714) 292-5302
San Francisco	The Computer Store 1083 Mission St.	(415) 431-0640
San Jose	Amco Electronics 414 S. Bascom Ave.	(408) 998-2828
San Jose	Byte Shop 155 Blossom Hill Rd.	(408) 226-8383
Van Nuys	Computer Components 3648 Sepulveda Blvd.	(213) 786-7411
<b>CONNECTICUT</b>		
Windsor Locks	The Computer Store 63 S. Main St.	(203) 627-0188
<b>FLORIDA</b>		
Coral Gables	Sunny Computer Stores 1238A S. Dixie Hwy	(305) 661-4042
Tampa	Microcomputer Systems 144 S. Dale Mabry Hwy.	(813) 879-4301
<b>GEORGIA</b>		
Atlanta	Atlanta Computer Mart 3091 4th Street Hwy	(404) 455-0647
<b>HAWAII</b>		
Honolulu	Compact Computers P.O. Box 10096	(808) 373-2751
<b>ILLINOIS</b>		
Champaign	The Numbers Rack 518 E. Green St.	(217) 352-9435
Evanson	Itty Bitty Machine 1216 Chicago Ave.	(312) 328-8800
Park Ridge	Chicago Computer Store 157 Hickory Rd., Hwy. 62	(312) 623-2388
<b>INDIANA</b>		
Indianapolis	Home Computer Shop 10447 Chris Dr.	(317) 894-3119
<b>MARYLAND</b>		
Rockville	Computer Workshop, Inc. 5709 Frederick Ave.	(301) 468-0455
<b>MASSACHUSETTS</b>		
Burlington	The Computer Store 120 Cambridge St.	(617) 272-8770
<b>MICHIGAN</b>		
Troy	General Computer Company 2017 Livernois	(313) 362-0022
<b>MINNESOTA</b>		
Minneapolis	Cost Reduction Services 3142 Hennepin Ave. So.	(612) 822-2119
<b>MISSOURI</b>		
Kansas City	Computer Workshop of Kansas City 5603 Blair Rd.	(816) 741-5055
<b>NEW JERSEY</b>		
Irvington	The Computer Mart 501 Route 27	(201) 283-0600
<b>NEW YORK</b>		
East Windsor	The Computer Mart of Long Island 2070 Front St.	(516) 794-0510
New York	The Computer Mart 314 5th Ave.	(212) 279-1048
<b>OHIO</b>		
Columbus	ComputerVision 894 W. Broad St.	(614) 228-2477
<b>SOUTH CAROLINA</b>		
Columbia	Byte Shop 2018 Greene St.	(803) 771-7824
<b>TEXAS</b>		
Houston	Communications Center 7231 Fender	(713) 774-9526
Richardson	The Micro Store 634 S. Central Expressway	(214) 231-1096
<b>WASHINGTON</b>		
Seattle	Retail Computer Store 410 NE 72nd St.	(206) 524-4101
<b>WISCONSIN</b>		
Beloit	Austin Computers 2835 Northgate	(608) 365-6096
Watertown	General Precision Electronics 207 Rhine St.	(414) 261-8148

**Compucolor Corporation**





# NOW \$2750. AMERICA'S LOWEST-PRICED PERSONAL COMPUTER SYSTEM WITH COLOR VECTOR GRAPHICS.



By taking advantage of the new technologies available to the industry today, we've consistently been able to give you one of the best prices on the market. Now because of great response, we can give you the best price. You can now buy the Compucolor 8001 for the reduced price of \$2750. A complete stand-alone system with expanded graphics software for plotting points, vectors and bargraphs on a 160 x 192 addressable grid—in color. Eight independent background and foreground colors.

The Compucolor 8001 has an Intel 8080 CPU, 34 I/O ports and a color display with an effective band width of 75 MHZ compared to 5 MHZ for standard TV sets. In fact the Compucolor is the only totally integrated system on the market which includes a color display. You can also have special options for the Compucolor 8001 right now, including: Mini Disk Drives for extra memory, light pens and a variety of special keyboard features.

**BASIC 8001 Is Easy To Learn.** Compucolor's BASIC 8001 is

a conversational programming language which uses English-type statements and familiar mathematical notations. It's simple to learn and easy to use, too. Especially when it comes to intricate manipulations or expressing problems more efficiently. The BASIC 8001 Interpreter runs in ROM memory and includes 26 statement types, 18 mathematical functions, 9 string functions and 7 command types for executing, loading, saving, erasing, continuing, clearing or listing the program currently in core.

**Expandable Memory To 64K.** The Compucolor 8001 has 11K bytes of non-destructible read-only memory which handles the CPU and CRT operating systems as well as BASIC 8001. Sockets are in place for an additional 21K of EPROM/MROM memory. The Random Access Main Memory has 8K bytes for screen refresh and scratch pad, 8K bytes for user workspace and room for 16K bytes of additional user workspace. The Compucolor also comes complete with a convenient mass storage device,

Floppy Tape Memory. It's an 8-track continuous loop tape system, with a Baud rate of 4800 and an extra storage capacity of up to 1024K bytes per tape.

## Color Graphics At Alphanumeric Black And White Prices.

That's what we're becoming famous for, and thanks to the tremendous response to the Compucolor 8001, we've been able to reduce our price even lower—to \$2750. Look over our dealer listing on the adjacent page for the dealer nearest you. Then drop by for a demonstration. And while you're checking out the Compucolor 8001, check out your dealer's financing plan. He can help you turn a good deal into a good deal more.

Compucolor Corporation,  
P.O. Box 569, Norcross,  
Georgia 30091.

**Compucolor Corporation**



19-24, June 26- July 1, July 10-15, July 17-22. The fee, including tuition, room and board, is \$125.

For further information contact Dr. John Kinney, Rose-Hulman Institute of Technology, 5500 Wabash Ave., Terre Haute, Indiana 47803.

## COMPUTER CHESS NEWSLETTER

A Santa Barbara microcomputer hobbyist, Douglas L. Penrod, is seeking articles for a proposed computer chess newsletter.

Penrod hopes to pattern his newsletter after Hal Singer's *Micro-8 Newsletter*. Besides seeking articles, Penrod is also interested in receiving feedback from other hobbyists on the format for the proposed newsletter should take.

Hobbyists interested in further information or contributing to the newsletter should contact: Douglas L. Penrod, 1445 La Cima Road, Santa Barbara, CA 93121.

## INTERNATIONAL DATA BASE CONFERENCE

The Third International Conference on Very Large Data Bases will be held in Tokyo on October 6-8, 1977. Co-sponsors of the event are IEEE Computer Society, ACM, The Information Processing Society of Japan, the International Federation for Information Processing and the Society for Management Information Systems.

The event will be the highlight of Japan's Information Week, October 1-7 which is expected to draw more than 100,000 participants. A wide range of subjects in the field will be covered.

Reduced pre-registration rates are available until September 15. Information is available from Mr. James Gabbert, MIT Sloan School, 50 Memorial Drive, Rm. #53-330, Cambridge, MA 02139.

## UPCOMING COMPUTER SHOWS MAY 77

Computer Caravan '77 has four remaining shows in New York, Philadelphia, Washington DC, and Boston. The forums will continue to be conducted by leading user or independent consultants who will lead seminars and workshops on these relevant, up-to-date topics.

Tuesday: Case studies in applying minicomputers.

Wednesday: Case studies in managing terminal networks.

Thursday: Case studies in improving software productivity. The remaining forums will take place from 9 AM to 1 PM. Concurrently, hundreds of exhibitors products and

# BASIC SOFTWARE LIBRARY NOW AVAILABLE AT THE FOLLOWING DEALERS

### ARIZONA

Byte Shop, Phoenix  
Sherman Oaks, AZ 85029  
602/942-7300  
Byte Shop, Tempe  
Tempe, AZ 85281  
602/964-1219  
Desert Data Computer  
Store  
Tucson, AZ 85702  
Smith Enterprises  
Phoenix, AZ 85040  
602/968-0774

### ARKANSAS

Computer Products  
Unlimited  
Little Rock, AR 72208  
501/371-0449  
CALIFORNIA  
AVI Electronics  
Long Beach, CA 90806  
213/428-9528  
Byte Shop, Inc.  
Sunnyvale, CA 94086  
408/374-9000  
Byte Shop, Berkeley  
Berkeley, CA 94703  
415/845-6366  
Byte Shop, Campbell  
San Jose, CA 95124  
408/377-4865  
Byte Shop, Diablo Valley  
Walnut Creek, CA 94596  
415/933-4352  
Byte Shop, Fresno  
Fresno, CA 93703  
209/480-2417  
Byte Shop, Hayward  
Hayward, CA 94541  
415/537-2863  
Byte Shop, Lawndale  
Lawndale, CA 90260  
313/731-7771  
Byte Shop, Long Beach  
Long Beach, CA 90815  
213/537-7771  
Byte Shop, Mountain View  
Mountain View, CA 94040  
415/968-5464  
Byte Shop, Palo Alto  
Palo Alto, CA 94306  
415/327-9200  
Byte Shop, Pasadena  
Pasadena, CA 91101  
213/684-0311  
Byte Shop, Sacramento  
Citrus Heights, CA 95610  
916/726-2357  
Byte Shop, San Diego  
San Diego, CA 92111  
714/685-8008  
Byte Shop, San Fernando  
Valley  
Fresno, CA 91356  
213/343-3919  
Byte Shop, San Mateo  
San Mateo, CA 94403  
415/341-4200  
Byte Shop, San Rafael  
San Rafael, CA 94901  
415/457-9311  
Byte Shop, Santa Barbara  
Santa Barbara, CA 93101  
805/966-2557  
Byte Shop, Santa Clara  
Santa Clara, CA 95051  
408/249-4221  
Byte Shop, Thousand Oaks  
Thousand Oaks, CA 91320  
805/497-9595  
Byte Shop, Walnut Creek  
Walnut Creek, CA 94596  
415/933-6252  
Byte Shop, Westminster  
Westminster, CA 92683  
714/694-9131  
The Computer Center  
San Diego, CA 92111  
714/292-3302  
Cone Computer  
Van Nuys, CA 91411  
213/786-7411  
The Computer Mart  
Orange, CA 92667  
714/633-1222  
The Computer Shop  
San Leandro, CA 94577  
415/995-9365  
Computer Power & Light  
Studio City, CA 91605  
The Computer Store  
Santa Monica, CA 90401  
The Computerists  
San Francisco, CA 94122  
415/566-1472

People's Computer Shop  
Sudbury, MA 01776  
213/789-7514  
Sunshine Computer Co.  
Carson, CA 90745  
213/327-2118  
Upland Computer Labs  
Upland, CA 91786  
714/981-1103

### COLORADO

Byte Shop/AspenCo  
Englewood, CO 80110  
303/761-1632  
Byte Shop, Boulder  
Boulder, CO 80301  
303/448-6233  
Byte Shop, Englewood  
Englewood, CO 80110  
303/761-1632  
Computer Hut  
Denver, CO 80202  
303/472-7070

### CONNECTICUT

The Computer Store  
Windsor Locks, CT 06096  
203/427-6188  
FLORIDA  
Byte Shop, Cocoa Beach  
Cocoa Beach, FL 32931  
305/784-1881  
Byte Shop, Miami  
Miami, FL 33135  
305/264-2983  
Computer Hut  
Miami, FL 33134  
305/821-2667  
MIAMI  
Miami, FL 33135  
305/264-2983  
Miami Lakes, FL 33014  
305/821-2667  
Micro Computer Systems  
& Sales  
Pompano Beach, FL 33068  
305/972-6063  
Micro Computer Systems  
Tampa, FL 33608  
813/978-4301  
Williams Radio & TV  
Jacksonville, FL 32209  
904/554-5468

### GEORGIA

Atlanta Computer Mart  
Atlanta, GA 30340  
404/455-0647  
The Computer System Center  
Atlanta, GA 30305  
404/231-1691  
HAWAII  
Precision Sys. of Hawaii  
Honolulu, HI 96826  
Precision Radio, Ltd.  
Honolulu, HI 96822  
808/537-5091  
ILLINOIS  
American Microprocessor  
Equipment & Supply Corp.  
Prarie View  
Chicago, Computer Store  
Park Ridge, IL 60068  
312/252-2888  
The Data Domain  
Evanston  
Evanston, IL 60201  
312/338-6600  
Lilipute Computer Mart, Inc.  
Skokie, IL 60076  
312/567-1363  
MPV Shop  
Evanston  
Evanston, IL 60201  
312/338-6600  
INDIANA  
Computer Specialists  
W. Lafayette  
317/743-1711  
The Data Domain  
Bloomington  
812/334-3607  
Chicago Electronics  
Indianapolis  
317/634-8202  
The Home Computer Store  
Indianapolis  
317/894-3319  
KENTUCKY  
Cybertronics  
Louisville, KY 40299  
502/496-1551  
The Data Domain  
Lexington  
606/233-3346  
MASSACHUSETTS  
Computer Mart, Inc.  
Waltham  
617/889-4540  
The Computer Store  
Burlington, MA 01803  
617/275-8770

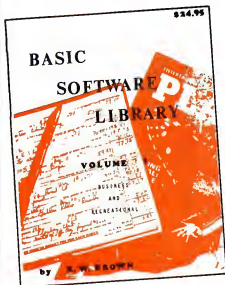
Computer Store, Sudbury  
Sudbury, MA 01776  
Computer Warehouse  
Boston  
617/281-2701  
MARYLAND  
Computer Workshop  
Rockville  
301/468-0455  
Science Education Ext.  
Ft. Belvoir  
301/299-0506  
MICHIGAN  
General Computer Co.  
Troy, MI 48064  
313/362-0022  
Computer Store of Ann Arbor  
Ann Arbor, MI 48104  
313/965-7616  
MINNESOTA  
Byte Shop, Eagan  
Eagan, MN 55124  
612/452-1841  
MISSOURI  
Computer Systems Ctr.  
Chesterfield  
314/576-5020  
Computer Workshop  
Kansas City  
816/741-5055  
Gateway Electronics  
St. Louis, MO 63130  
314/427-6116  
Micro Com, Inc.  
Kansas City  
816/333-8383  
NEW HAMPSHIRE  
Computer Mart of NH  
Nashua  
603/883-2386  
Microcomputers, Inc.  
Nashua  
603/889-1646  
NEW JERSEY  
Computer Mart of NJ  
Iselin  
201/283-0600  
Hoboken Computer Works  
Hoboken  
201/426-1844  
Williams Electronic Supply  
Edison, NJ 08817  
201/956-3700  
NEW MEXICO  
The Computer Shop  
Albuquerque, NM 87110  
505/883-6282  
NEW YORK  
Byte Shop, Levittown  
Levittown  
916/731-6116  
Computer  
Computer Mart of LI  
E. Meadow  
516/794-0510  
Computer Mart of NY  
New York City  
212/279-1045  
Computer Mart of NY  
Manhasset, NY 11030  
516/828-9063  
Computer Shop Systems Inc.  
Dewitt, NY 13041  
518/446-1284  
The Computer Store  
Albany, NY 12211  
518/459-6146  
The Computer Store  
New York, NY 10018  
212/221-1404  
MiniMicroMart  
Syracuse  
315/422-1487  
Synchro-Sound Enter.  
Hollis  
212/468-7087  
OHIO  
Digital Design  
Cincinnati  
513/561-6733  
OKLAHOMA  
Altair Computer Center  
Tulsa, OK 74135  
918/684-4564  
Bts, Bytes & Micros  
Oklahoma City  
405/947-5646  
High Technology  
Oklahoma City  
405/842-2021

### OREGON

Byte Shop, Beaverton  
Beaverton  
503/644-4866  
Byte Shop, Portland  
Portland  
503/223-3496  
PENNSYLVANIA  
Byte Shop, Bryn Mawr  
Bryn Mawr  
215/255-7712  
Personal Computer Corp.  
Frister  
215/917-8480  
RHODE ISLAND  
Computer Power, Inc.  
Narraville, RI 02886  
401/738-4477  
SOUTH CAROLINA  
Byte Shop, Columbia  
Columbia  
803/771-7824  
TENNESSEE  
Byte Tronics  
Nashville  
615/235-1979  
Micro Computer Sys.  
Knoxville, TN  
615/235-1979  
TEXAS  
Altair Computer Ctr.  
Houston  
713/780-8981  
The Byte Shop, Houston  
Houston, TX 77058  
713/777-0604  
Computerlux  
Houston  
713/256-3456  
Houston Computer Mart  
Houston, TX 77055  
713/619-9224  
Interactive Computers  
Houston  
713/772-5257  
K A Electronics  
Dallas  
214/634-7870  
Micro Store  
Dallas, TX 75205  
214/231-1086  
SWIP Computer Store  
San Antonio  
512/344-0241  
UTAH  
Byte Shop, SLC  
Salt Lake City  
801/355-xxxx  
The Computer Room  
Salt Lake City, UT 84105  
801/468-7911  
VIRGINIA  
Computer Hobbies, Unid.  
Richmond  
814/276-5256  
Shire Enterprises  
Richmond  
814/321-4500  
WASHINGTON  
Altair/Stratum Elec.  
Seattle  
206/763-2300  
Byte Shop, Bellevue  
Bellevue, WA 98004  
206/476-0651  
WEST VIRGINIA  
The Computer Store  
Charleston  
304/345-1360  
Westconsin  
Microcomp  
Fon du Lac  
414/822-2515  
The Milwaukee Computer Store  
Milwaukee  
414/323-9140  
CANADA  
Byte Shop, Vancouver  
Vancouver, BC  
604/736-7221  
The Computer Shop  
Calgary, Alberta T2T 4T9  
403/243-0301  
The Pacific Computer Store  
Vancouver, BC  
604/438-3282  
Trintronics  
Toronto, Ontario  
416/598-0282  
JAPAN  
Byte Shop, Tokyo  
Chiyodaku, Tokyo

# FANTASTIC SOFTWARE

This **LIBRARY** is a complete do it yourself kit. Knowledge of programming not required. **EASY** to read and **USE**. Almost **FREE** Less Than \$1 / Program Complete



VOLUME I .. \$24.95  
BOOKKEEPING  
GAMES  
PICTURES

VOLUME II .. \$24.95  
MATH & ENGINEERING  
PLOTTER & STAT

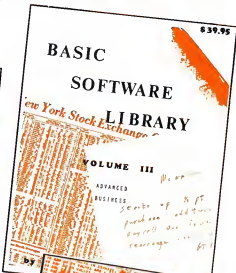
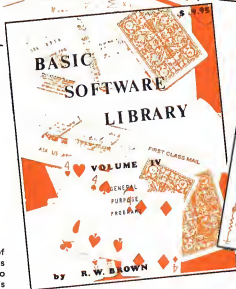
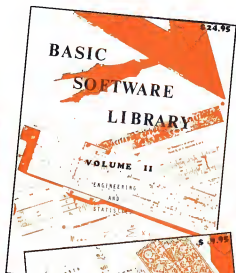
BASIC STATEMENT DEF

VOLUME III .. \$39.95  
ADVANCED BUSINESS  
BILLING

INVENTORY  
PAYROLL

VOLUME IV .. \$9.95  
GENERAL PURPOSE

VOLUME V .. \$9.95  
EXPERIMENTER



This library is the most comprehensive work of its kind to date. There are other software books on the market but they are dedicated to computer games. The intention of this work is to allow the average individual the capability to easily perform useful and productive tasks with a computer. All of the programs contained within this Library have been thoroughly tested and executed on several systems. Included with each program is a description of the program, a list of potential users, instructions for execution and possible limitations that may arise when running it on various systems. Listed in the limitation section is the amount of memory that is required to store and execute the program.

Each program's source code is listed in full detail. These source code listings are not reduced in size but are shown full size for increased readability. Almost every program is self instructing and prompts the user with all required running data. Immediately following the source code listing for most of the programs is a sample executed run of the program.

The entire Library is 1100 pages long, chocked full of program source code, instructions, conversions, memory requirements, examples and much more. ALL are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers available for 8080 and 6800 under \$10 elsewhere.

Available NOW !!! at most computer stores

The "HOW-TO-DO IT" Books for the "DO-IT" Person

Written in compatible **BASIC** immediately executable in **ANY** computer with at least 4K, **NO** other peripherals needed.

See Our List Of Dealers

Add \$1.50 per volume for postage and handling.

## SCIENTIFIC RESEARCH

1712-I FARMINGTON COURT  
CROFTON MD 21114

Phone Orders call (800) 638-9194

Information and Maryland Residents Call (301)-721-1148



Personal checks — allow 4 weeks for shipping. Pricing subject to change without notice. If air mail shipping is desired add \$3 per volume to price, Continental U.S. only. Foreign orders add \$8 for each volume.

# CALENDAR

services will be shown at Computer Expo 77 each day from 10 AM to 5 PM. There will be no admission charge to the exhibit halls.

May 10-12 New York Colliseum

May 24-26 Philadelphia Convention  
May 31-June 2 Sheraton Park Hotel, Washington D.C.

June 7-9 Boston MA. Northeast Trade Center (Rte. 128, exit 39).

For registration to any of the forums or other information write:

Registration Office

Computer Expo 77

797 Washington St.

Newton MA 02160.

(617) 965-5800

May 10-12 Chicagoland Business Services and Equipment Exposition at the ExpoCenter in Chicago IL. For more information contact: Carleton Rogers, Industrial and Scientific Conference Management Inc., 222 West Adams St., Chicago IL 60606. Or call (312) 391-9810.

May 11-15 Milan Italy. Computers, related equipment and systems exhibition at the U.S. Trade Center in Milan Italy.

May 16-20 London Great Britain. Telecommunication Equipment Exhibition at the U.S. Trade Center.

May 17-19 Nippon East. Philadelphia Civic Center. Exhibitor Conferences and products will be featured. Call Frank L. Buccaro at (312) 263-4866 for more details.

May 24-26 Geneva Switzerland, International Microcomputers-Microprocessors '77.

May 28-29 Mid-America Computer Conference, Wichita KS. A hobbyist and small business forum and exhibits.

June 5-8 Chicago IL. Summer Consumer Electronics Show.

June 10-12 Computex '77 Cleveland OH. The second annual Computex '77 sponsored by the Midwest Affiliation of Computer Clubs Inc., will be held at the Bond Court Hotel, 777 St. Clair Ave., Cleveland OH. The ticket price of \$2 will provide you with admission to seminars, technical sessions, flea market, and a manufacturers exhibit area. There will be prizes, games, and demonstrations. The show is open to all interested parties.

The Annual Club Congress of the Midwest Affiliation of Computer Clubs will be held at this event. This congress is open to all club members, trustees, and officers. For further information on the Computex '77 send a stamped self-addressed envelope to MACC, P. O. Box 83, Brecksville OH 44141.

May 4 New England Computer Society, Inc. will be meeting in the cafeteria of the Mitre Corp. at 7 PM. Located on Rte. 62, in Bedford, Ma. Contact Dave Day at (603) 434-4239 for details.

May 4 Northwest Computer Club will be meeting at 7 PM at the Pacific Science Center, Room 200, located on 2nd Av. in North Seattle WA 98109. A graphics show is scheduled for this month.

May 7 Louisville Area Computer Club meets at 1 PM in the Speed Auditorium at the University of Louisville, KY 40200. Details are available from Glenn Darwing at (502) 456-5589.

May 7 Ventura County Computer Society (SCCS) will meet at 7:30 PM at the Camarillo Public Library located at 3100 Ponderosa Dr., Camarillo CA. For more information write: VCCS, P.O. Box 525, Port Hueneme CA 93041 or call (805) 985-2631.

May 7 South Central Kansas Amateur Computer Association meets at 9 AM at 1430 E. Kellogg in Wichita KS 67200. Call Cris Borger at (316) 265-1120 for details.

May 8 South Eastern Michigan Computer Organization (SEMCO) will meet at 6 PM at the studios of WJBK-TV-2. Call President Dick Wier at 565-3228 for club agenda.

May 12 Rochester Area Microcomputer Society (RAMS) meets at the Rochester Institute of Technology, Bldg. 9, Room 1030 at 7:30 PM. For further details write RAMS, P.O. Box D, Rochester NY 14609.

May 13 Homebrew Computer Club meeting will begin at 7 PM in Menlo Park, CA at the Stanford Linear Accelerator Center Auditorium. Contact Bob Reiling at (415) 967-6754 for meeting details.

May 13 Crescent City Computer Club will meet at 8 PM at the University of New Orleans, Lakefront Campus. Call Bob Latham at (504) 722-6321 for club details.

May 13 Northern New Jersey Amateur Computer Club (NNJACC) will be meeting at the Fairleigh Dickinson University, Rutherford Campus, Becton Hall Room B8. For more information write to NNJACC, 593 New York Av., Lyndhurst NJ 07071.

May 14 Oklahoma Computer Club will be meeting at the Belle Isle Library at 10 AM. Call Al Campbell at (405) 842-4933 for the club agenda.

May 17 Rhode Island Computer Hobbyist (RICH) Club. Contact Roger Garrett at 16 Grinnell Street, Jamestown RI 02835 for meeting place and time.

May 19 New York Amateur Computer Club will meet at 7 PM. Call Bob Schwartz for meeting place at (212) 663-5549.

May 20 Long Island Computer Association meets at the New York Institute of Technology, Bldg. 500, Room 508 at 8 PM in Old Westbury NY 11803. Call (516) 938-6769 for further details.

May 21 South Central Kansas Amateur Computer Association will be meeting at 9 AM at 1430 E. Kellogg in Wichita KS 67200. Call Cris Borger at (316) 265-1120 for club details.

May 22 Chicago Area Computer Hobbyist Exchange (CACHE) will meet at 12 PM in the cafeteria of the NIGAS Bldg. on Schermer Rd., Glenview IL. Call or write to CACHE, P.O. Box 36, Vernon Hills IL 60061 or (312) 620-1671.

May 24 Sacramento Microcomputer Users Group (SMUG) meeting will commence at 7:30 PM in the SMUG Training building on 59th Street between R and S streets. Write SMUG, P.O. Box 741, Citrus Heights CA 95610.

May 25 Northwest Computer Club meets at 7 PM in Room 200 at the Pacific Science Center in North Seattle WA 98109

May 25 Homebrew Computer Club meets at 7 PM at the Stanford Linear Accelerator Center Auditorium. Call Bob Reiling at (415) 967-6754 for details.

May 25 Ventura County Computer Society (VCCS-SCCS) will meet at 7:30 PM at the Camarillo Public Library located at 3100 Ponderosa Drive, Camarillo CA. For Club details write VCCS, P.O. Box 525, Port Hueneme, CA 93041 or call (805) 985-2631.

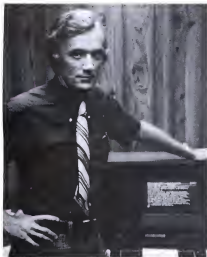
May 25 Diablo Professional Users Group will meet at 8 PM at the library conference room of the Diablo Valley College. For more information call Bob Hendrickson at (415) 687-8373.

May 26 Small Computer Engineering Association of Minnesota (SCEAM) will hold its meeting at 7 PM at 3010 4th Av., South Minneapolis, MN 55408 near Lake and Nicollet streets. Call (612) 824-6406 for more information.



# SENSE LINE

Bill Savedge



This column is the first in a series. It is designed to aid the many computer clubs, associations, and societies throughout the many countries in which **INTERFACE AGE** reaches. The 'Sense' line will research your operational problems, and attempt to give public advice to improve the situation. This advice or direction will be interfaced with a few convictions of my own. Reader response is welcome, as well as problems relating to your club. Be sure to include the club name, a person's name who is familiar with the problem and the phone number, so I can review the situation with them, and receive approval or disapproval to use the club name at the end of the case problem. In regards to a reader response, I will use only initials and city of origin when comments are used.

I'd like to begin this column with the subject of being positive. A positive attitude among the club officers and its members is part of what makes a club successful. On the other hand, a negative attitude results in dissension, low attendance at club meetings, and eventual club failure. How often have you heard these excerpts:

1. "I'm not going to bring my system. I've finally set it up, besides, everyone else will bring in theirs".
2. "If we don't get some support

on this newsletter, we will be forced to discontinue it".

3. "Well does anyone have anything to share with us this month?"
4. "I'm not going to the meeting this month, it's always the same".

These are just a few of the examples of negative attitude. I'm sure you could add to the few examples I've given. The worst thing that could happen to a club is radiating a negative attitude, affecting both the club's officers and its members. The club officers should be the ones to alter this attitude. Keep the theme of

the meetings positive. For example, No. 3, If you would try 'Well, if nobody has anything to contribute, we're going to...' and come up with a project that will keep the interest of the members. Newsletters reflect the attitude of your club to everyone on the mailing list, as well as other readers. This is the main item to keep positive. For example, 'We still have a little space of next month's issue', with 'little' as the key word to keep it positive.

Next month, I will relate a few ideas to make those meetings more positive by offering examples of variety.

## Socket to the Bugs for Life.



**\$16.50\***

The highest quality socket in the industry now carries a new low price and a new lifetime guarantee. E&L guarantees the SK-10 socket against all failures. Should it ever break, be damaged or fail to perform as described, return it to E&L postpaid for a free replacement. No questions asked.

We can offer such a guarantee because the SK-10 is a top quality socket built tough for years of use. Integrated circuits and discrete components insert directly without adapters. No patch cords needed. And, of course, no soldering.

For the life of your bugs, pick up an SK-10 today. They're available at your local computer store for only \$16.50\*.

\* Suggested resale price.  
Dealer inquiries invited.

**E&L<sup>®</sup>**

**E&L INSTRUMENTS, INC.**

61 First Street, Derby, Conn. 06418  
(203) 735-8774 Telex No. 96 3536

CIRCLE INQUIRY NO. 10

# ...FROM THE FOUNTAINHEAD

By Adam Osborne

Now that the Intel 8085 and 8048 are here, IMSAI is going for these two products; IMSAI is not planning to offer a Z-80 CPU card. I wonder why the Z-80 and the Intel products have to be mutually exclusive?

I have had a chance to examine the 8085 and the 8048—and I believe some intriguing user patterns are likely to emerge.

Let us begin by comparing the 8085 with the Z-80, both of which purport to be the "next generation" 8080-A.

These are the two major faults of the 8080-A:

a) The 8080-A is really a three-chip CPU, consisting of the 8080-A CPU, the 8224 clock generator and the 8228 system bus controller.

b) The 8080-A requires three power supplies: +5V, +12V and -5V.

Both the 8085 and Z-80 have eliminated these two problems; CPU logic has been reduced to a single chip which requires a single +5V power supply.

Now to you as a hobbyist, these two 8080-A problems may seem a bit abstruse, but chips and power supplies both cost money; these two 8080-A problems have resulted in higher cost 8080-A CPU cards.

But while eliminating two problems, the 8085 seems to have introduced a new one—multiplexed data and address busses.

The 8085 instruction set is almost identical to that of the 8080-A; the 8085 has just two new instructions. The Z-80 instruction set, as all you hobbyists know, is about twice the size of the 8080-A instruction set. Instruction sets are very important to hobbyists, but not very important to large commercial users who often pay more attention to chip counts and part costs.

Along with its enhanced instruction set, the Z-80 contains additional registers within its CPU. The 8085 registers are identical to the 8080-A's.

The Z-80 provides logic to refresh dynamic memories which the 8085 does not do. What this means is that it is cheaper to interface large, low cost memories to a Z-80 than it is to an 8085.

The Z-80 has three modes in which its interrupt logic may operate, but it has just two interrupt request pins. The 8085 has five interrupt request pins, three of which generate their own dedicated Restart instructions.

The 8085 has a primitive serial input and output capability, which the Z-80 does not have.

Now we could go on comparing

"features", since that is very subjective. More often than not advertised features are nothing short of marketing propaganda. In fact, I define a "feature" as a design error which the manufacturers could not get out in time, so they gave it to marketing to dress up as an asset.

But what is far more important is that I believe I can identify key aspects of the 8085 versus the Z-80 which are going to direct the two products into somewhat different markets.

The Z-80 has an instruction set which people who do much programming appreciate; it also has signals and internal characteristics which make it more attractive than the 8085 in large microcomputer systems. For example, dynamic memory is cheaper than static memory, but that only becomes a significant cost factor in large memories.

However, the 8085 has a secret trump card—at least for the moment—its support devices, the 8155, the 8355 and the 8755.

The 8155 provides 256 bytes of read/write memory, three I/O ports and a programmable timer, all on a single chip. The 8355 provides 2048 bytes of ROM and two I/O ports, on a single chip. The 8755 is a variation of the 8355 having erasable PROM. Now you can put together some rather interesting two-chip and three-chip systems based on the 8085, the 8155, the 8355 and the 8755. Putting together similar systems using the Z-80 would require considerably more logic and expense. The 8155, 8355 and 8755 internally demultiplex the 8085 data and address busses which you must demultiplex externally if you're going to have larger 8085-based systems—at which time the Z-80 will generate lower chip counts and costs.

In summary, I believe the 8085 will have difficulty dislodging established Z-80 users, and there are many of them, particularly among hobbyists. The 8085 will also have a hard time competing with the Z-80 in large microcomputer systems, or programming intensive microcomputer applications. But the two-chip and three-chip 8085 configurations are going to look very attractive to commercial users who are interested in large volumes and low chip counts and cannot get by with the one-chip microcomputers now appearing on the market (the Fairchild 3859, the Mostek 3870 and the Intel 8048). Since hobbyists are not part of the high volume, price sensitive market, what this means is that the 8085 will be having a hard time competing with the Z-80 for new hobby market



# Complete Control.



## Introducing IMSAI 8048 Single Board Control Computer.

### Complete Control System

Intel developed the world's first single chip microcomputer. IMSAI has built the system to put it to work. Instantly!

Presenting the IMSAI Single Board Control Computer. A complete program-mable computer and hardware control system on an 8½" x 10" board.

Just plug in the power source (a 5V power supply or a 6V battery will do), and you can be controlling your home environment today!

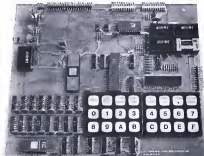
### The Chip Designed for Control

Intel designed the 8048/8748 single chip microcomputer with one thought in mind. Complete control. Everything you need is there: CPU, RAM, 1K ROM/EROM, I/O, timer/counter, interrupts . . . the works.

### The Board That Implements It Instantly

There's a 24 pad hexadecimal keyboard and 9-digit LED hex display already on board. So you can start controlling the colleeport and the sprinklers the minute you get the IMSAI home. Without adding anything but the connecting wires.

You can run almost any peripheral available. Not to mention the kids' electric train. The IMSAI Control Computer is



RS232 compatible. There are 12 quasi-bidirectional I/O lines with handshaking, and 14 more regular I/O lines, 5 heavy duty relays, and Teletype and audio cassette interfaces. All on one board.

There's already an extra 1K of RAM on board, plus sockets for another 1K of RAM and 2K of ROM/EROM. Still need more memory? The IMSAI 8048 allows expansion up to 64K of RAM off board.

Ultimately, the only limit to this system is your imagination.

Now, that's control.

For instant control, use the coupon provided.

### GENTLEMEN:

I want instant control!

- ☐ Send ROM Computer Kit \$249\*
- ☐ Send EROM Computer Kit \$399\*
- ☐ Send assembled ROM Computer \$299\*
- ☐ Send assembled EROM Computer \$499\*
- ☐ Send 5V power supply \$99

\*June delivery.

Check/MO enclosed. Amt. \$

Charge my: ☐ BAC ☐ M/C

# \_\_\_\_\_ Exp. Date \_\_\_\_\_

Sig. \_\_\_\_\_

☐ Send more information.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State/Zip \_\_\_\_\_

# IMSAI®

IMSAI Manufacturing Corporation  
14860 Wicks Blvd.  
San Leandro, CA 94577  
(415) 483-2093  
TWX 910-366-7287

# A NEW BOOK From Osborne & Associates

## "SOME COMMON BASIC PROGRAMS"

### Table of Contents

- Future Value of An Investment
- Future Value of Regular Deposits (Annuity)
- Regular Deposits
- Regular Withdrawals from an Investment
- Initial Investment
- Minimum Investment for Withdrawals
- Nominal Interest Rate on Investments
- Effective Interest Rate on Investments
- Earned Interest Table
- Depreciation Rate
- Depreciation Amount
- Salvage Value
- Discount Commercial Paper
- Principal on a Loan
- Regular Payment on a Loan
- Last Payment on a Loan
- Remaining Balance on a Loan
- Term of a Loan
- Annual Interest Rate on a Loan
- Mortgage Amortization Table
- Greatest Common Denominator
- Prime Factors of Integers
- Area of a Polygon
- Parts of a Triangle
- Analysis of Two Vectors
- Operations on Two Vectors
- Angle Conversion: Radians to Degrees
- Angle Conversion: Degrees to Radians
- Coordinate Conversion
- Coordinate Plot
- Plot of Polar Equation
- Plot of Functions
- Linear Interpolation
- Curvilinear Interpolation
- Integration: Simpson's Rule
- Integration: Trapezoidal Rule
- Integration: Gaussian Quadrature
- Derivative

By  
**Lon Poole**  
**Mary Borchers**



Now, 76 BASIC programs ready to run and fully debugged available from Osborne & Associates.

- Twenty financial programs
- Twenty-seven mathematical programs
- Eighteen statistical programs
- Twelve more programs of interest to everyone

These programs are written in a form of BASIC that most compilers can accept without modification.

- Roots of Quadratic Equations
- Real Roots of Polynomials: Newton
- Roots of Polynomials: Half-Interval Search
- Trig Polynomial
- Simultaneous Equations
- Linear Programming
- Matrix Addition, Subtraction, Scalar Multiplication
- Matrix Multiplication
- Matrix Inversion
- Permutations and Combinations
- Mann-Whitney U Test
- Mean, Variance, Standard Deviation
- Geometric Mean and Deviation
- Binomial Distribution
- Poisson Distribution
- Normal Distribution
- Chi-square Distribution
- Chi-square Test
- Student's t-distribution
- Student's t-distribution Test
- F-distribution
- Linear Correlation Coefficient
- Linear Regression
- Multiple Linear Regression
- N th Order Regression
- Geometric Regression
- Exponential Regression
- System Reliability
- Average Growth Rate, Future Projections
- Federal Withholding Taxes
- Tax Depreciation Schedule
- Check Writer
- Recipe Cost
- Map Check
- Day of the Week
- Days between Two Dates
- Anglo to Metric
- Alphabetize

For ordering and pricing information please contact (or use form below):

OSBORNE & ASSOCIATES, INC.

P.O. Box 2036 • Berkeley, California 94702  
• (415) 548-2805  
• Department C

OSBORNE & ASSOCIATES, INC.

### BOOK ORDER FORM

TITLE	UNIT PRICE	QUANTITY
Volume I — Basic Concepts (#2001)	\$7.50 ea.	
Volume II — Some Real Products (#3001)	\$12.50 ea.*	
8080 Programming For Logic Design (#4001)	\$7.50 ea.	
8800 Programming For Logic Design (#5001)	\$7.50 ea.	
Some Common BASIC Programs (#21002)	\$7.50 ea.	

\*Price will be \$15.00 effective June 1977 for revised edition of Volume II.

☐ Check or Money Order enclosed.

☐ Purchase Order enclosed (we will only invoice for orders over ten).

☐ I require information on consignments, discounts and for distributors outside the U.S.A.

☐ BankAmericard No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

☐ Master Charge No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature: \_\_\_\_\_

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY, STATE and ZIP \_\_\_\_\_

TELEPHONE \_\_\_\_\_

COMPANY \_\_\_\_\_

In which publication did you see our ad?

Price includes 4th class mail delivery within the U.S. in 3 - 4 weeks. For faster delivery include \$1.50 extra per book for shipping and handling. Shipping charges for bulk, discounted orders to be arranged. Include appropriate sales tax for California residents.



business. Of course, manufacturers now using the 8080-A will probably switch to the 8085.

But when will one of you hobbyists come up with a Z-80 assembler that uses 8080-A mnemonics?

What about the 8048? The 8048 is Intel's answer to the one-chip microcomputers being manufactured by Fairchild (the 3859) and Mostek (the 3870). IMAI is the first manufacturer to produce an 8048 microcomputer card for the hobbyist. As a programmer you will find the 8048 highly restricting in its one-chip form. This one chip gives you a total of 64 bytes of data memory and 1024 bytes of program memory. The 8748 gives you an EPROM, but at a price which rivals a multiplex Z-80 microcomputer configuration.

If you take the 8048 and expand it into a multiplex microcomputer, with a quantity of external program memory and data memory, then you finish up with a microcomputer system that costs the same as a Z-80, or an 8085, but is much harder to use; and that makes no sense.

The 8048 is not really a programmer's product; it is not well suited to the average hobbyist's needs. But this is a microcomputer which you will love if you are building dedicated controllers. If you use

microcomputers as instrument controllers in a laboratory, if you are a ham radio operator who wants to use microcomputers for dedicated control functions, even if you're running your model railroad at home with a microcomputer, then you will love the 8048 — or most specifically the 8748 for its simplicity and ease of configuration. If you are using the 8048 as a dedicated controller, you will likely want analog-to-digital and digital-to-analog converters. Check with Precision Monolithic Inc. (408-246-9222) for some interesting new one-chip A/D and D/A converters.

And now for a few tidbits from other manufacturers.

National Semiconductor has been amazed at the response the SCMP keyboard kit system has generated among hobbyists. Apparently hobbyists account for the bulk of keyboard kit customers. National now has a 4K basic available for SCMP; which they call "Nibble". But National does not yet have a real hobby microcomputer system. Despite rumors that National Semiconductor is imminently going to enter the hobby market, no decision to that effect has yet been made.

One of the most interesting chips due later this year is the 9511 arithmetic processing unit from Ad-

vanced Micro Devices. This chip will give microprocessors high speed arithmetic comparable to large microcomputers. The 9511 makes multidigit multiplication and division and floating point arithmetic cheap and practice. I predict it will be one of the hottest chips of 1978.

Two more hot tips: Gary Killdall, who goes by the name "Digital Research" and works in Monterey, California (408) 373-3403 produces the best software we have seen yet. Mr. Morro of Morro's Microstuff has been designing some very good \$100 boards.

In my first article I explained that I had selected the name "From the Fountainhead" since the area from which I am reporting contains most of the manufacturers and important companies in the microcomputer industry. Manny Lemas of Microcomputer Associates was dismayed when his company and its products — the Jolt microcomputer system and "Microcomputer Digest" magazine — did not appear in my list of company names. I forgot to mention you Manny, so here is the mention.

And in case you want to be mentioned, either for your products or your opinion, please call me. My telephone number is (415) 548-2805.

## FRANKLIN ELECTRIC Co.

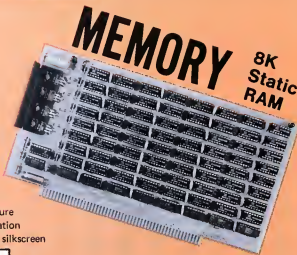
### altair - IMAI - S-100 BUS COMPATIBLE

#### Check these features ...

- ACCESS TIME — 450ns No wait states
- FULLY BUFFERED — for BUS reliability
- LOW POWER CHIPS — for long life and low power drain
- MEMORY WRITE PROTECT — Hardware, 2K segments
- POWER REGULATION — 4 Regulators for reliability
- ADDRESS SELECT — 8K boundaries - Dip. Switch
- LED MEMORY SELECT INDICATOR — Visual Check
- LED MEMORY PROTECT INDICATOR — Visual Check
- BATTERY BACKUP PROVISION — Saves memory during power failure
- OUTPUT DISABLE — Switch selectable for transparent loader application
- P.C. BOARD — Quality G10 material with solder mask both sides and silkscreen
- SOFTWARE — Diagnostic provided

#### Price

- KIT — With IC Sockets ..... \$239
- KIT — Without Sockets ..... \$225
- Solder chips directly to PCB
- ASSEMBLED — With Sockets ..... \$295
- ASSEMBLED — Without Sockets ..... \$280



#### To Order

Name \_\_\_\_\_ Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Enclosed is \$ \_\_\_\_\_ Check ☐ Money Order ☐  
Bill my BankAmericard ☐: Master Charge ☐: Card No. \_\_\_\_\_  
Exp. Date \_\_\_\_\_ Interbank No. \_\_\_\_\_  
Signature \_\_\_\_\_

Handling and Postage \$2.50. California Residents add 6% sales tax.

FE

FRANKLIN ELECTRIC Co.

733 LAKEFIELD ROAD

WESTLAKE VILLAGE, CA 91361  
(805) 497-7755

# COMPUTRAC

## State-of-the-Art Century-old Record Newest Microprocessor

by Robert Cheeseboro

Mechanisms for playing records have been around for 100 years or so, and until recently, have performed the limited function of playing the record from *beginning to end*. The only fundamental improvements in phonograph design made during that time were the addition of automatic set-down and lift of the tone-arm, and the development of the automatic changer mechanism for stacked records. Of course, there has been a tremendous advance in tone-arm pick-up technology, in particular, the introduction of the magnetic-coil transducer cartridge.

Nevertheless, the phonograph turntable as we have known it through the years has, with few notable exceptions, remained basically the same and has not kept adequate pace with the dramatic improvements which have been made in phonograph record technology. Modern disc records only remotely resemble their earlier ancestors, even those produced as recently as 20 years ago. Vastly improved vinyl materials and compounds used in the manufacture of today's phonograph records make possible extremely low-noise, high-signal recordings with extended play life and anti-warp characteristics. In addition, the development of the "micro-groove" cutting process allows for extremely high groove packing density per radial inch, which translates into longer play time per side (in excess of 20 minutes) if desired by the recording studio programmer. Lastly, the newly-developed vinyl materials with their high-resolution replication properties make possible the 45,000 Hz carrier frequencies required for high-fidelity 2- and 4-channel stereo recordings which are in mass-production today.

Within the past two years, however, a quiet but dramatic revolution in record player design has started to unfold, in most part initiated by relative newcomers into the ranks of the phonograph equipment manufacturers; Cheeseboro Products Corporation is one such innovative new company. The two most significant of these design advances are straight-line tangential tracking and the servo-controlled direct-drive turntable.



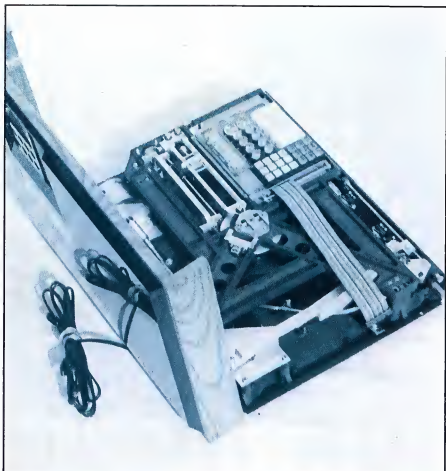
# 2000

## Marriage of Player Market to Technology

The quantum jumps made during the past decade in electronic solid-state control technology made the direct-drive turntable motor a reality, since such a motor needs a servo-control system in order to maintain the constant speed required by the rotating disc record. Extremely fine speed control of the turntable is essential in order to reproduce the very high-fidelity recordings made today, and the direct-drive turntable eliminates the use of drive belts and speed reducers which cause rumble, speed error, and wow and flutter. Such disturbances are easily detectable when reproduced on today's expensive, high-resolution amplifiers and speaker systems.

**Within the past years  
a quiet revolution in  
record player design  
has taken place:  
straight-line  
tangential tracking,  
servo-controlled  
turntable and now  
microprocessor-  
controlled  
pin-pointing.**

The recent introduction of straight-line, tangential-tracking record players, specifically those marketed by Bang & Olufsen (B & O) and Harman-Kardon (Rabco), addresses the other principal deficiency of older standard record players. This concerns the anomaly of a horizontally-pivoted, 8- to 12-inch long tone-arm attempting to reproduce faithfully music information originally recorded in a straight line by the cutting lathe to the center of the master record. Since the standard pivoted tone-arm describes an arc as it traverses the record, the sound reproduced thereby is a distortion of the original recording. This is the "tracking error"—lack of tangency to the record groove—caused by the arc of travel of the pick-up needle to the center of the record.



## END FRONT PANEL FIDDLING...

Use a

# JUMP START™ 4K RAM

With a **JUMP START** 4K RAM board in your Altair/IMSAI, the system will jump to any preset byte of memory after power-up or reset. Never toggle a jump to your monitor or bootstrap again! Just power-up or hit reset—**JUMP START** automatically transfers control to the selected address. The **JUMP START** 4K RAM board has these standard features:

- 4K 450 ns low power RAM
- fully buffered
- DIP switch address selection
- memory protect with POC
- battery backup connector
- fully socketed
- disabled during INTA
- optional wait state

#### Prices:

Kit	\$145
Assembled	190

Call toll-free anytime to  
place credit card orders:

800/648 5311

Prepaid mail orders shipped postpaid  
in USA. California residents add 6%  
sales tax.

## MICROMATION

MICROMATION INCORPORATED  
524 UNION STREET  
SAN FRANCISCO, CA. 94133  
415/398-0289

Dealer inquiries invited

CIRCLE INQUIRY NO. 30

The servo-driven tangential-tracking tone-arm phonograph players marketed by B & O and Rabco do indeed tend to correct the horizontal tracking error problem (though both units depend upon a slight arc of horizontal tone-arm movement to activate the servo drive), but they also create many other problems and reliability considerations because of their complexity. So, though these straight-line tracking units substantially eliminate the horizontal tracking-error problems, the fact that they still employ a lengthy tone-arm causes them to retain many of the deficiencies of the standard tone-arm, such as vertical tracking angle error, tone-arm resonance, excessive tone-arm mass to tracking force ratio, and the need for massive counterweights in an attempt to counterbalance the heavy tone-arm weight. In addition, all of the present units, both standard and servo-driven tone-arm types, leave the ever-more-delicate tone-arm and pick-up cartridge needle exposed to inevitable damage by the user, as well as damage caused by exposure to dust and other uncontrollable contaminants and damage.

The development of the **COMPUTRAC 2000** by Cheeseboro Products Corporation comes as a result of an intensive 15-year effort to remedy the problems associated with standard record players, during which time we introduced the **SWINGER STEREO 70**, which featured a free-floating, fully compliant radial-tracking pick-up cartridge system, all housed in a compact, totally enclosed housing, capable of operation in the vertical as well as horizontal positions. The **COMPUTRAC 2000** not only eliminates mechanical problems, but advances the state-of-the-art in such devices considerably beyond the simple record-playing function and into the realm of random programming, an essential requirement for the creative end of today's music and broadcast industries, as well as providing home entertainment versatility for the enjoyment of the consumer.

This programming capability is made possible by the application of the microprocessor in combination with the radial-tracking mechanism in the patented design. The ability to access rapidly across the surface of the record disc in a pre-determined and precise fashion opens a whole new world of uses for the record player which were not possible as long as record players were confined to the simplistic play-only modes.

The microprocessor-programmable control arrangement of the **COMPUTRAC 2000** gives the user operating

choices during play of the record that were previously unavailable, and full control over which passages or portions of passages on a record to be played, and in any sequence desired. This design enables the user to select the precise beginning and ending points of a recorded passage (or portions thereof) of interest, to program the player to repeat the selected passage any number of times desired, and to play the desired passages in any sequence desired, even sequences different from the sequence defined in the phonograph record.

**The microprocessor  
enables the user to  
make playing choices  
on his record in  
whatever sequence  
and repeat these  
sequences as desired**

Commands for such operations may be entered into the record player manually by the user at the time of playing of a particular record, or the necessary commands may be recorded on the label of the record itself for use later when it is actually desired to play the record. The latter feature is potentially of great benefit to radio stations, recording studios, music composers, programmed learning, dance studios and discotheques, as well as ordinary home users who desire to program the playback sequence on their records. It is anticipated that, if adopted by record producers, the inclusion of pre-recorded position information on the record label will vastly simplify the tasks of playback programming by the many users listed above, and also will make possible the automation of many more record players in the future. It should be noted, at this point, that there has been one notable record player introduced into the marketplace which allows pre-programming of passages on a record during play: the **ACCUTRAC** by ADC. However, the **ACCUTRAC** has limited programming capacity and can program full recorded selections only, since it works on the principle of a light source and detector finding the smooth spaces (or lands) between the recorded passages. Hence, the programming of the **ACCUTRAC** essentially directs the detector to "count" the lands and to play the passages of interest, in the randomized sequence entered into the memory.



On the other hand, the **COMPUTRAC 2000** does not depend on a light-detecting principle which relies on scanning the record during play, rather makes full use of the capabilities of the microprocessor to handle the inputs of real-time pick-up position data and its ability to store and organize that data, as well as its capacity simultaneously to accept the input of digital data from the control keyboard. In particular, the micro-computer in the **COMPUTRAC 2000** knows at all times where the pick-up needle is in relation to its starting and stopping point. This is accomplished by the use of a servo-driven pick-up cartridge "follower" mechanism assembly, which will be discussed later.

As mentioned previously, the **COMPUTRAC 2000** makes possible unique programming sequences, such as for example those desirable for use by radio station personnel. Existing radio station audio programming equipment requires multiple operating modes and have controls which at first appear complex. In broadcast studios under the pressure of real-time conditions associated with live radio or television broadcasts, the workload on a studio technician can be very high. The **COMPUTRAC 2000** uses dual interlocking approaches, made possible by the application of the microprocessor, to alleviate this workload. The selection and scheduling chores, i.e., the decisions as to which passages or portions of passages to play from various records, can be performed in advance of the actual broadcast. Next, the microprocessor handles much of the operational logic and decision-making process by, in effect, instructing the user to do first this and then do that. Passage selection, either from a multiband phonograph record or of a selected portion from a single-band recording such as a symphony, can be predetermined precisely by reference to the digital display and readout on the control panel which, through the radial-tracking "follower" mechanism in the record player, displays the position of the pick-up needle on the record with an accuracy of about 0.02 millimeter, which is about the width of a record groove. Programming instructions peculiar to a given record can be encoded on the record itself, in a form which can be changed at a later time, through the medium of the annular magnetic tape which can be adhesively affixed to the record by the user, or provided by the record manufacturer.

Space does not permit a detailed description of the many other features and functions of the **COMPUTRAC 2000** in addition to the very impor-

# OUR PROTO-CLIP<sup>TM</sup> CAN PAY FOR ITSELF THE 1ST TIME YOU USE IT.

The reason's as simple as the time you'll save testing, signal tracing or wiring in DIP's. Not to mention the cost of IC's ruined by accidental shorts. A Proto-Clip is the foolproof, short, proof way to bring up leads from crowded circuit boards. Its patented, molded design and unique gripping teeth free hands for other work. Built to withstand tough day-to-day use, CSC clips are available with or without cable for 14-, 16-, and 24-pin DIP's, starting at \$4.50! For more information, see your dealer or write for our full-line catalog and distributor list.



CONTINENTAL SPECIALTIES CORPORATION

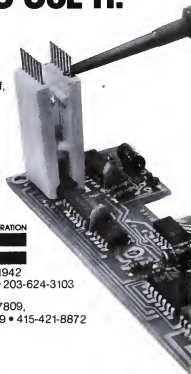


44 Kendall Street, Box 1942  
New Haven, CT 06509 • 203-624-3103  
TWX: 710-465-1227  
West Coast office: Box 7809,  
San Francisco, CA 94119 • 415-421-8872  
TWX: 910-372-7992

U.S. Pat. No. 3,914,007

\*Mfr's sugg. retail

© 1975, Continental Specialties Corp.



## CIRCLE INQUIRY NO. 5

### DIGITAL DATA RECORDERS

**MODEL 3M3** Featuring the radically new "Uniboard" method of construction for data cartridge drives. The major computer makers are changing to cartridges at a rapid pace because of the freedom from binding and greater data reliability. Operates in the phase encoded self-clocking mode which provides greatly enhanced freedom from speed variation problems and allows 100% tape interchangeability between units.

Uses the 3M Data Cartridge, model DC 300. This cartridge contains 300 feet of .250 tape in a sealed plastic container. Using four tracks you can record nearly 2 megabytes of data on a cartridge.

### CONTROLLING I/O BOARDS

#### 2510(R) CONTROLLER (Bootstrap Eliminator)

This is a complete 8080, 8085, or Z80 system controller. It provides the terminal I/O (RS232, 20 ma., or TTL) and the data cartridge I/O, plus the motor controlling parallel I/O latches. One kilobyte of on board ROM provides turn on and go control of your Altair or Imsai. No more bootstrapping. Loads and Dumps memory in Hex on the terminal, formats tape cartridge files, has word processing and paper tape routines. Best of all, it has the search routines to locate files and records by means of six, five and four letter strings. Just type in the file name and the recorder and software do the rest. Can be used in the BiSync (IBM), BiPhase (Phase Encoded) or NRZ modes with suitable recorders and interfaces.

Write for full details and product information.

"COMPUTER AID" and "UNIBOARD" are trademarks of the NATIONAL MULTIPLEX CORPORATION. The 3M Data Cartridges are covered by 3M Patents and Marks. "UNIBOARD" Patents Pending.

### NATIONAL MULTIPLEX CORPORATION

3474 Rand Avenue, South Plainfield NJ 07080, Box 288,  
Phone (201) 561-3600 TWX 710-997-9530

## CIRCLE INQUIRY NO. 38

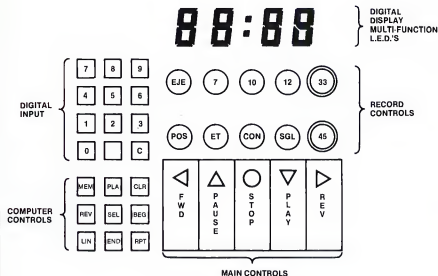


Figure 1. Control Panel

## Instruction set

### Record controls

**EJE:** Causes record loading door to open, lifts pickup.

**7, 10, 12:** Determines positioning of arms on record loading door for 7-inch, 10-inch, 12-inch records.

**33, 45:** Determines turntable speed. Both knobs have fine-tuning rings. Speed is shown by LEDs (e.g. 33.33) **POS:** Shows needle position in mm from ending position. Count starts at 96.00, is shown by LEDs.

**ET:** LEDs show elapsed playing time in minutes and seconds.

**CON:** Replays record continuously until STOP button is actuated.

**SGL:** Shuts off player after one side of record.

### Main controls

**FWD:** Lifts cartridge, traverses toward center of record. Play resumes when button is released.

**PAUSE:** Lifts pickup cartridge, stops position count, stops time accumulation, enables memory for programming.

**STOP:** Lifts pickup cartridge, reverses turntable motor, lowers turntable, shuts off motor. LEDs display hours, minutes and (with flashing colon) seconds.

**PLAY:** Loading door closes; turntable lifts record and rotates; record plays as instructed.

**REV:** Lifts pickup, traverses toward

starting position. Play resumes when button is released.

### Computer controls

**MEM:** Activates write head for recording onto magnetic track on record. **PLA:** Enables programming of play sequence.

**CLR:** Clears display digits.

**SEL:** Designates selection of interest. User enters number (see POS) on digital input section.

**BEG:** Beginning of selected passage. User enters position information.

**END:** End of selected passage. User enters position (manually, or automatically from POS reading).

**RPT:** User enters number of times passage is to be repeated.

**REV:** Recalls, displays either MEM recorded program or PLA recorded program. Changes in program can be made while REV is on.

**LIN:** Program is displayed line after line. Allows user to locate spot in program for re-recording.

### Digital input

**0-9:** input buttons

**C:** Correction

### Multi-function LED display

Unless otherwise used as indicated above (position, elapsed playing time), shows time of day when STOP is depressed, or player is not on; stops time display when EJE is depressed.

tant position control feature described in the foregoing. However, we will list them briefly, and call attention to the detail of the control panel for the specific location of the corresponding pushbuttons which initiate these additional features. (Figure 1)

- \* Powered record loading
- \* 7, 10, or 12-inch record size automatically selected
- \* Push-button selection of 33 or 45 RPM turntable speed, which causes servo control of the direct-drive motor.
- \* Single or continuous record playing mode
- \* Fast forward and reverse pickup cartridge movement (stepper motor slews in either direction at 500 pulses/second)
- \* Powered pause
- \* LED display of Time-of-day, Elapsed time, Pick-up needle position, Turntable rotational speed, and Program data stored in memory.
- \* Full micro-computer control of all functions of the record player memories
- \* Control of remote devices (tape unit, amplifier, etc.) by use of remote terminals in rear of unit.

The basic element of the overall control system is the central processor unit, an INTEL 8080 with an internal clock circuit module and a control module. The control module is an INTEL 8228 IC, (see Figure 4 and subsequent schematics).

The ROM and RAM units shown in Figure 3 each have 8K of memory capacity. The ROM controls the interlock between lift solenoid and stepper in its high speed mode to traverse the cartridge and stylus in a lifted position above the record to a new designated position. The ROM also controls the L.E.D.'s. The RAM serves as the data storage bank for playback programming.

Apart from numbers storage and processing, the micro-computer within the **COMPUTRAC 2000** also handles logic functions through a ROM associated with the microprocessor. The effect, from the point of view of the user, is an optical "guided tour" through what essentially is an operating manual for the record player. This is accomplished through the medium of lighted pushbuttons and other controls on the control panel. Improper commands entered into the unit by the user are defeated, and the next proper command is indicated as the appropriate control pushbutton is illuminated in the proper sequence. It should be evident, however, that a user of the **COMPUTRAC 2000** may choose to ignore the various control options possible, and employ only three or so of the

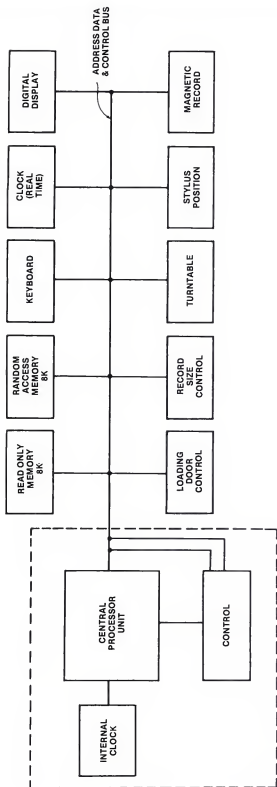


Figure 3. Control System.

# MERLIN

## THE INTELLIGENT VIDEO INTERFACE

MERLIN is the best ASCII/Graphics board now available for the S-100 bus . . . and at an unbelievable price!

Compare these features to any other video interface:

- ☆ 160H x 100V resolution bit mapping graphics
- ☆ On-board ROM (Monitor/Editor) option
- ☆ 40 characters by 20 lines, character ROM generated (hardware)
- ☆ Keyboard interface (with power)
- ☆ Programmable modes and display format
- ☆ Serial I/O port
- ☆ Low power . . . only 600ma at +5V
- ☆ Extremely fast (uses DMA)
- ☆ Comprehensive User Manual . . . 200ps
- ☆ American 60HZ or European 50 HZ operation.

Designed-in expandability means maximum versatility at minimum cost. Add-on options now available (in kit form) include:

- ☆ Super Dense Graphics (M320-K) . . . . . \$39
- ☆ Lower case characters (LC) . . . . . \$25
- ☆ Serial-to-parallel expansion Kit (MSEK-K) . . . . . \$45
- ☆ 1500 Baud (software) cassette interface kit (MCAS-K) . . . . . \$29
- ☆ 2K x 8 Mask ROM; graphics, cassette, & extended editing software (MEI) . . . . . \$35
- ☆ 2K x 8 Mask ROM/256 RAM; Monitor Editor Software (MBI) . . . \$39

The MBI ROM software is designed to allow turnkey operation and sophisticated editing and scrolling.

Ask to see a demonstration of MERLIN at your nearest computer store. Many dealers now stock MERLIN and there is nothing like a hands-on demo for really evaluating a product. We know you'll be sold.

MERLIN Kit with Manual . . . . . \$269  
MERLIN, assem'd & tested . . . . . \$349  
MERLIN User Manual . . . . . \$ 10

For fast information, write us direct!  
MC and BAC accepted.



MiniTerm Associates, Inc.

Box 200 Danbury, CT 06810 (203) 746-1226

CIRCLE INQUIRY NO. 33

INTERFACE AGE 21

main controls to operate the record player in a less sophisticated manner. And when required, potentially complex programming operations are simplified by the functional organization of the control pushbuttons on the control panel. If, for example, a recorded sound background to be used in a radio broadcast is required to end precisely with the last word of a spoken passage by an announcer, the microprocessor can be programmed to start the recorded passage precisely at the point desired by the user on the record of interest.

The pick-up cartridge "follower" assembly referred to above is the key to the positioning data input

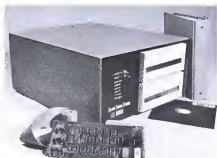
for the microprocessor, as well as the mechanism for positioning the pick-up cartridge in response to the pre-programmed sequenced desired by the user. The follower assembly is located in relation to the pick-up cartridge so that it moves along a path parallel to the travel of the needle as it tracks radially to the center of the record. The "follower" does not touch the pick-up cartridge during normal operation, but lifts the pick-up during pause, and carries the pick-up at high speed during fast forward or reverse operations. The follower contains a light source and two photodetectors which sense the movement of the pick-up cartridge

as it travels across the record during play, and, through a servo-controlled stepper motor which drives the "follower's" lead-screw, always tends to the "null" or "zero" position in relation to the centerline of the pick-up needle. The logic and memory sections of the micro-computer in the record player control system includes a counter in which is accumulated a count of the pulses operating the stepper motor driving the "follower" member from any given position along its path of movement parallel to the pick-up cartridge back to its starting position.



## IF I'D ONLY KNOWN, I WOULD HAVE BOUGHT THIS ASSEMBLED!

- It isn't as simple as it seems to adopt a floppy disk system to your microprocessor. You need power supplies, interface card, controller, cables, fan and a cabinet to put it in. In most cases you have to modify the disk software for your computer.
- The Syntec Designs Company FDS-2 FLOPPY DISK system comes complete with ICOM™ assembler, text editor, and executive system—all packaged in an attractive cabinet. Because it is ready to run, there is no software patching for I/O handlers, initialization routines, or vector assignments.
- Save yourself Frustration. Buy Syntec Designs Company's FLOPPY DISK SYSTEM.



Contact your local computer store or write:

 **Syntec Designs Company.**

P.O. Box 2627  
Pomona, California 91766  
Phone: (714) 629-1974

CIRCLE INQUIRY NO. 56

**The COMPUTRAC 2000 represents a significant advance in the state-of-the-art in record players and opens the door for development of automated library systems.**

It is this count which is actually assigned to memory when the microprocessor in the record player is programmed to determine the manner and sequence in which a given record is to be played. A position pushbutton (POS) on the control panel causes the count, in millimeters from the starting position, to be displayed on the 4-digit LED display panel. (Figure 2—a and b)

The **COMPUTRAC 2000**, therefore, represents a significant advance in the state-of-the-art of record players, and is the pre-cursor of even more dramatic possibilities in record playback mechanisms. These include an Automated Home Record Library, which would store hundreds of records in a dust-free enclosure which would play records in response to the user demand. The **COMPUTRAC 2000** can be utilized with built in video display of the functions in operation, for O.E.M. applications in furniture, teaching systems, computer systems, shipboard and airborne sound systems; video-disc applications for inexpensive audio and visual playback units; as well as other unknown applications. The totally-enclosed design and functionally pure shape of the **COMPUTRAC 2000** opens a whole new era of concepts in styling freedom, allowing the unit to establish standards indicative of the future of the record player mechanisms yet to be designed.

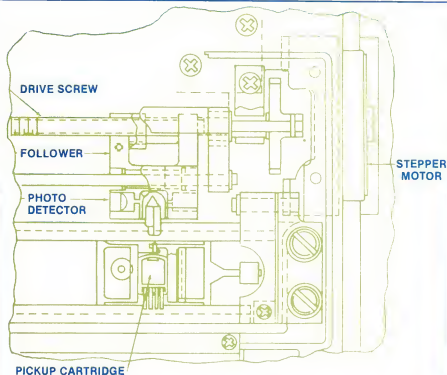


Figure 2b. Cartridge and Follower — Topview

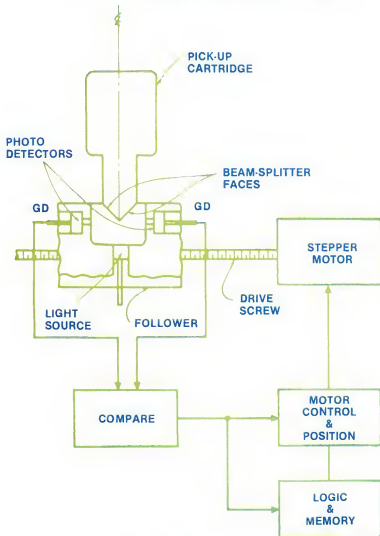
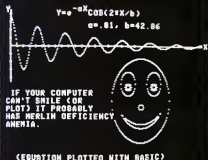


Figure 2a. Cartridge Follower Control Circuit

## SUPER DENSE GRAPHICS

320 Horizontal by 200 Vertical



The MERLIN Super Dense add-on kit provides maximum resolution at a minimum cost. In fact, MERLIN with Super Dense has more capabilities than any other S-100 bus video interface at any price!

Once you've seen 'Super Dense' graphic resolution you'll know there is nothing to compare it to . . . short of spending over \$600 . . . and even then you'll not have all of the capabilities of MERLIN with 'Super Dense'.

Super Dense provides true bit-mapping. Each and every point on the screen is controlled directly by a bit in memory. (Requires 8K of system memory.)

ROM character-graphics looked good for a while; then came MERLIN's 160 by 100 bit mapping graphics; and now . . .

**320 by 200 bit-mapping graphics!!**  
If you're looking for a graphic display, MERLIN with Super Dense is the best there is. And if you hadn't considered graphics or thought it was out of your price range, consider what you could do with 320 H by 200V graphics and for only \$39 extra.

The Super Dense add-on kit to the popular MERLIN video interface is now available with off-the-shelf delivery.

M320-K, Super Dense Kit . . . \$39  
M320-A, Super Dense Assm. . . \$54  
See MERLIN ad on previous page.

For information fast, write direct, or see 'Super Dense' at your nearest computer store.

MC and BAC accepted.



MiniTerm Associates, Inc.

Box 258, Bedford, Mass. 01730 (617) 448-1200

CIRCLE INQUIRY NO. 34



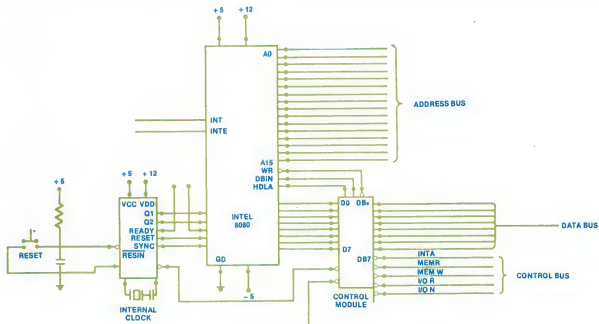


Figure 4. Central Processor

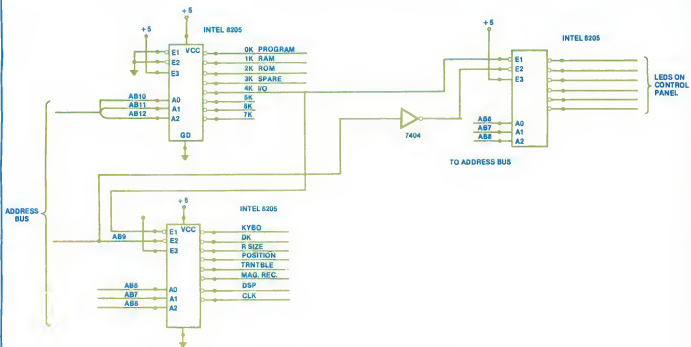


Figure 5. Address Decode Sub-System

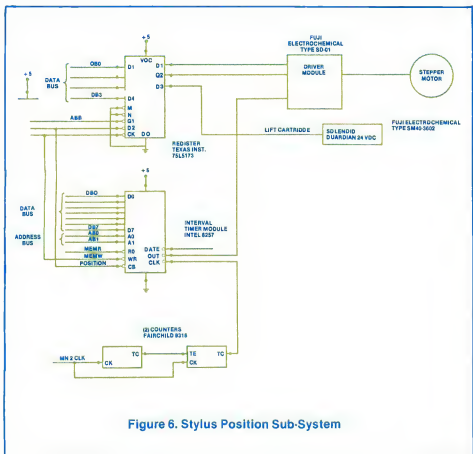


Figure 6. Stylus Position Sub-System

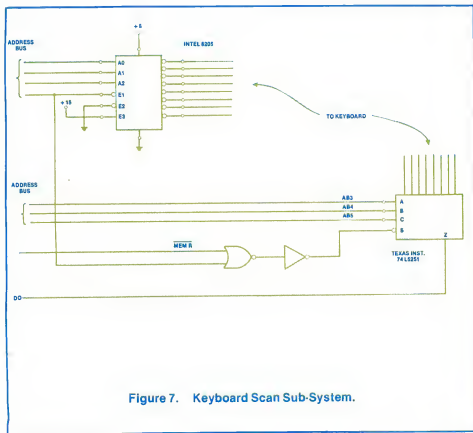


Figure 7. Keyboard Scan Sub-System.

## ROM MONITORS ARE GREAT!!!

They can transform a hobby computer into a professional, useful tool.

But why pay \$300 for one? The MERLIN Video Interface is also a ROM Monitor board. The optional 2K x 8 MBI ROM Monitor/Editor is available for only \$39.

The MERLIN Monitor provides commands for turnkey 8080 or Z80 operation and program debugging and the Editor is the best there is. Any BASIC or user program is compatible with the MBI software.

And now MiniTerm introduces the ROM/EROM kit so that you can put the rest of your operating system and general purpose routines in ROM for increased ease of use and reliability.

Just Look at these features:

- ⚡ Power-on jump to any 1K block
  - ⚡ Holds eight 2708 EROMs
  - ⚡ Bank select feature
  - ⚡ 5-100 bus compatible
  - ⚡ Wait state logic
  - ⚡ Addressable to any 4K block
- And it's only \$89 in kit form!

So write or buy your operating system — then optimize it for your specific needs and put it into ROM where it will always be available and yet changeable when necessary.

MiniTerm will also provide 2708s for \$40 and will introduce its Inexpensive 2708 programmer next month.

Once you've had or used a system with good ROM operating software (Monitor, Editor, Relocatable loader) you'll understand why ROM boards are becoming so popular.

But don't spend more for ROM boards with extra goodies when all you need is a board to hold your ROMs and to provide power-on jump. Buy the MiniTerm ROM/EAROM kit for only \$89.

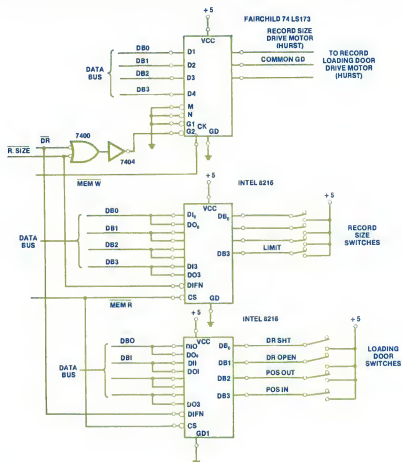
For more information fast, write direct.

MC and BAC accepted.

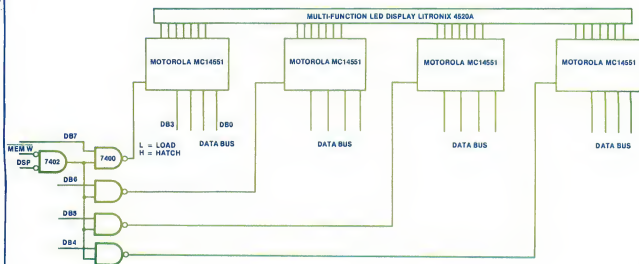


MiniTerm Associates, Inc.

Box 265, Bedford, Mass. 01730 (617) 448-1300



**Figure 8. Record Loading Door And Record Size Control Sub-System.**



**Figure 9. Digital Display Drive Sub-System**

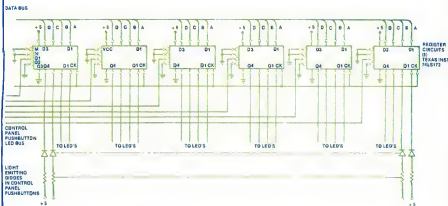


Figure 10. Control Panel Lighting Sub-System

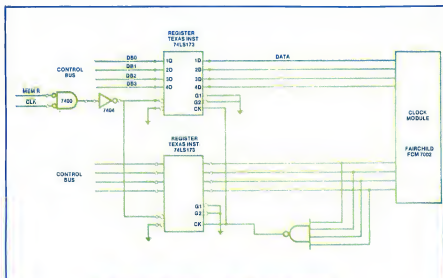


Figure 11. Real-Time Clock Sub-System

## PARALLEL I/O BOARD for only \$45 !!!

Made possible by the designed-in expansion capabilities of the impressive MERLIN Video interface.

Aside from general purpose uses, the designers at MiniTerm anticipated Graphics and Graphics games and the problem of control interfacing. The MSEK (MERLIN Serial Expansion Kit) provides:

- Three parallel input ports
- Three parallel output ports

These can be used for interfacing joysticks or game controllers or parallel I/O devices. And the price can't be beat! The MSEK mounts inside your keyboard and connects to MERLIN through the keyboard cable.

## SPACE WAR!

Also available from MiniTerm is the first real raster graphics "Space War" game for the personal/hobby market.

"Space War" gives the user control of rotation, acceleration, and firing of missiles for two space ships. When used on the MERLIN video interface with "Super Dense" add-on option (320 x 200) the game provides more excitement than any BASIC version of "Space War" or any of the standard TV games!

A deluxe version of "Space War" is also available which allows selection of ship dynamics to simulate cars, tanks, boats, etc. and allows the user to draw his own 'ship'.

Space War (SPW) .....\$25  
Deluxe Space War (DSPW) .....\$35  
(Add suffix -T for Tarbell tape, or -P for INTEL hex paper tape.)

A complete source listing is available for an additional \$10 for either game.

Write for full description, or better yet, play a few rounds at your local computer store. But be prepared to stay a while. There is likely to be a line and you may become addicted.

MC and BAC accepted.



MiniTerm Associates, Inc.

Box 225, Scituate, Mass. 01902 (617) 648-2202

CIRCLE INQUIRY NO. 36

# THE FLOPPY-ROM™ EXPERIMENT

## —Or the Joy of Developing a Simple Idea

by Robert S. Jones, Publisher

Seldom does one have the chance to participate in a new and exciting event which could initiate a programming revolution.

The Floppy-ROM™ has just such a potential.

With great pride INTERFACE AGE Magazine presents this pioneering special feature in this issue. We invite our colleagues in the publishing field to join with us in providing our combined readership with this important advantage of mass-distributed software.

### Our plans for the future call for more Floppy-ROMs™ supporting the 8080, Z-80 and 6502 CPUs.

It would be a pleasure to say that it was our idea, but unfortunately we cannot take that credit. Neither was it developed nor debugged by us. And in that point lies the real story.

This event is the achievement of many manufacturers and retail computer stores who have worked together on this project.

The story began at the Personal Computing '76 Trade Fair at Atlantic City, NJ when Bob Marsh of Processor Technology Corp. proposed the idea of pressing software onto a vinyl record. (We are including a milestone chart in Figure 1 to outline the events leading up to the present success.)

Processor Technology provided a test 8080 program which was recorded on a master disc. Unfortunately it did not work when tested. The designers at that time were unable to devote further development to the project.

Southwest Technical Products and Technical Design Labs were then contacted and positive commitments resulted.

Dan Meyer and Gary Kay of SWTPC co-ordinated the participation of Robert Uiterwyk, Software Consultant to much of the industry.

At this point activity split. The record manufacturer, EVA-TONE of Deerfield, IL, pursued an independent research to improve the recording technique. Ethan Lazar and Perry Farazi of Itty Bitty Machine Co. in Evanston, IL played a major role with EVA-TONE in producing four TV games on a record as a test which was later refined into a recording technique by the engineering personnel from Heath Co., Benton Harbor, MI. They brought their system into EVA-TONE's facility and worked directly with the recording engineers. The third record was cut with excellent results.

While this was taking place at EVA-TONE, Robert Uiterwyk, consultant Bill Turner and Bill Blomgren of MicroComputer Systems, Inc., Tampa, FL were preparing the final program and documentation which appear in this issue. These gentlemen worked many long hours in co-ordinating, developing and evaluating the pre-production test data.

Our thanks to Bruce Van Natta and Mike Stone, marketing manager of IMSAI; Dan Meyer and Gary Kay of SWTPC who co-ordinated Robert Uiterwyk's work; to Tom Durston and Ed Roberts, president of MITS, for all their valuable assistance and input in the pre-production testing stage of the Floppy-ROM™.

MITS plans to publish a loader in "Computer Notes" which will allow all 6800 owners to use this Floppy-ROM™.

Our special thanks goes to Carl Evans of EVA-TONE whose patience and steadfast support made the Floppy-ROM™ a reality.

Our plans for the future call for more Floppy-ROMs™ supporting the 8080, Z-80 and 6502 CPUs.

In order to continue this program, we ask for your response to the questions listed below for you are the key to its success.

Please send your responses and any comments as soon as possible to: Floppy-ROM™, INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, CA 90701.

### SURVEY

#### QUESTIONS

1. Did your magazine with the Floppy-ROM™ arrive in good condition via the Post Office?
2. What kind of record player did you use? Approximate cost?
3. What type of cartridge is on your turntable, magnetic or ceramic? If you know, tell us the brand and model.
4. What model cassette interface did you use?
5. Whose 6800 system did you use? Tell us the manufacturer's name, not your friend's.
6. What is the memory size of the 6800 system and what peripheral do you have?
7. Did you have trouble loading the record?
8. How many times did you have to try loading before you were successful?
9. Did you have any difficulties that prevented it from operating at all? If so, what were they?
10. Did you load the computer directly from the record through the interface?
11. Did you record on cassette and from there to the computer? What happened?
12. What kind of tone control settings did you use and were they critical?
13. Was the playback level critical?
14. Did you play it back in monaural or stereo?
15. Do you like the Floppy-ROM™ concept?
16. What kinds of programs would you like to see in the future?

See page 83 for the  
Milestone Chart on the  
development of the  
Floppy-ROM™



# PLATTER BASIC

## The Search for a Good, Random Access, Record Cutting Juke Box

by William Blomgren

### WHY "PLATTER BASIC" ON A FLOPPY-ROM?"

This is really a two-part question. First, why BASIC at all? The need for high level software is fairly self-evident, and BASIC will be explained in a second article later in this issue. For now, let's just settle with "Why a floppy-ROM?" or platter?"

Low cost software distribution is a recurring problem. It just appears that "low cost" and "high reliability" just don't seem to mix. Shipping programs in ROM, at several dollars per copy, is too expensive. All magnetic media cost too much, are fairly bulky, and are fragile. Machine readable print requires a fair amount of hardware. The bar code reader that we have located costs well over \$100. Most people do not have a bar code reader, nor even access to one, but many do have some sort of record player. A conventional record costs a fair amount, and is relatively fragile. The "sound Sheet" or floppy-ROM contained in this issue is low in cost, and best of all, requires little more than a record player and your cassette interface.

### WHAT'S ON THE RECORD?

There are two different sections on the record. First are the test patterns to align your cassette interface. The second section is the software you will want to load into your 6800 based microcomputer. This section of the record includes a binary loader program, and the binary dump of BASIC.

### WHAT WILL I NEED TO USE THE RECORD?

A 6800 based microprocessor system is a must. A minimum amount of memory considered should be 6K. In addition, a Kansas City Cassette interface is also a must, and some sort of 300-baud terminal is desirable to check the alignment of your cassette interface. A cassette machine should be used to save BASIC once it gets loaded, because the record will have limited life. Don't rely on it for more than ten or twenty loads because it will wear out. Basic assumes that MIKBUG is resident in your system, with a scratchpad from A000 to A07F. Patching instructions are provided in an appendix to this article for those systems that do not have MIKBUG and the scratchpad. A separate loader program is also supplied for those without a MIKBUG loader. Several SWTPC 6800 systems have been used by various individuals in verifying the concept behind BASIC on a "floppy-ROM", so owners of those systems should not have any trouble at all. Last but certainly not least, a 33-1/3 RPM (*Roms Per Magazine* . . . or is it revolutions per minute???) turntable.

### HOW WAS THE PLATTER MADE?

This section was not designed to be a discussion of how to cut a record, rather is a bit of history describing the path that BASIC took finding its way into INTERFACE AGE. This is not the whole path either, but just the side trip it took through MicroComputer Systems, Inc. to generate the record.

In late February the disc project was mentioned to me, and I approved. This was later followed by the request "Dump a copy of version-2 4K BASIC on a reel-to-reel." I grabbed a machine, and recorded the dump in Motorola MIKBUG format. This hexadecimal checksum dump took seven-and-a-half minutes. I found out an hour later, that there was a 6 1/2 minute time limit. *Back to the old drawing board.* . . .

I gathered together a test pattern routine, and a binary dump and load routine, recorded them on tape, and sent them to EVA-TONE. Naturally, Murphy's First Law of Shipper-Smashing held true. The reel of tape arrived in seven pieces. The people at EVA-TONE managed to salvage the tape, however, and cut a sample disk. The test patterns looked great, but there was a drop out in the middle of the loader. It was a non-recoverable fault, so again I went through the entire procedure. The record worked well the second time. Level and tone settings however, were very critical. Carl Evans at EVA-TONE suggested a direct dump from the computer into their cutting equipment. *Back again to the old drawing board.*

I rewrote the machine code that generated the test patterns and dumped BASIC, so that they would need no operator assistance. I shipped a program tape off to Illinois. A computer store in that area provided the use of a Southwest Technical Products 6800 computer, and the dump was on. I received a telephone call asking how to use my dumping routine — I told them to just load it and type 'G'. Sure enough, Lady Luck was now on my side; it worked. Elimination of the intermediary tape stage was very important; they managed to do a direct dump into the cutting equipment with perfect results. A one-to-two DB variation was noted in the tapes I sent them, and this would present problems to many people. The direct dump eliminated this entirely.

The masters have traveled across the entire country several times, and final approval was finally made for production. The production pressings worked and the end result is here in INTERFACE AGE.

### WHAT IS THE "KANSAS CITY STANDARD?"

The "Kansas City" recording standard was established to allow interchange of data and programs between microcomputer users. It allows great latitude in playback speed, and can be used with almost any cassette

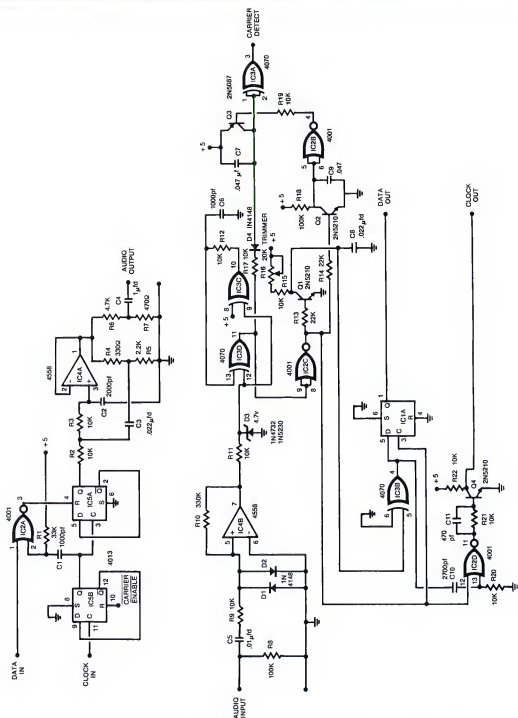


Figure 1. SWTPC AC-30 Cassette Tape Modulator/Demodulator Schematic

machine. "Marks", or logic ones, are represented by a frequency of 2400 Hz, and "spaces", or logic zeros, are represented by 1200 Hz. Data is transferred using the standard UART format, (1 start bit, 1 stop bit) at 300 baud. (Roughly thirty characters per second.) These frequencies were chosen because the 16X clock for the UART can be easily derived from the data being fed into the interface. Speed tolerances of 20- to 30% are acceptable. Figure 1 shows the circuit of the Southwest Technical Products AC-30. It is a fairly simple circuit, which will allow entry of the program into your system. With this circuit, or its equivalent, the program on the "floppy-ROM" may be read.

## HOW DOES IT WORK?

Audio is fed through the highpass filter made up of R9 and C5. It is clipped by the pair of diodes, and fed into IC-4B, which acts as a comparator. IC-4 should be fed a well regulated 7.5V supply, to ensure stable operation at this point. Zener diode D3 limits the output of IC-4 to levels acceptable to the CMOS gate that follows. When the comparator changes state, IC-3C and IC-3D generate a short (5 microsecond) negative pulse. When data is being received, these pulses repeat. This train of negative pulses grounds C7 through D4. The output of C7 is inverted, buffered, and can be used to generate a carrier detect signal. These negative pulses are found at pin 11 of IC-3D. They're inverted by IC-2A, where they

# Think about it!

If you could design  
your own computer system  
from scratch,  
you'd do it right.

You'd want...



CIRCLE INQUIRY NO. 15

feed four circuits. The first circuit is a missing pulse detector, made up of Q2 and IC-2B. They pull the Carrier detect signal low if several cycles of audio are lost.

The second circuit is an adjustable missing pulse detector, which "times out" when 1200 Hz data are received. R16 trims this time period. The third circuit is flip-flop IC-1A, which outputs the data. Its output is high when 1200 Hz is received. The last circuit is the clock synthesizer, which is made up of IC-2D and IC-3B. These generate the 16X clock for your UART.

## HOW DO I HOOK UP A TURNTABLE?

The AC-30 requires about 5 volts of signal to decode the data on the floppy record. Speaker output jacks will easily supply this level. Before you hook up Junior's phonograph, check to see if it has a transformer - Isolated chassis. If it doesn't, *don't hook it up!* It would be all too easy to get 120V of your local power utility into your computer. This would tend to make a very expensive pile of write-only memory. If necessary, have a technician check out your stereo. Some component pre-amps are capable of driving 5 volts. A Dyna Pat-4 was used to test the records, and that worked nicely. However, it had to be turned up all the way. If your stereo set has a MONO-STEREO switch, set it on mono. A large percentage of noise on this type of disc is vertical. The vertical signal is essentially a "difference" signal for stereo, but is unwanted for this playback. It will cancel nicely, which will help load a very noisy disc.

Adjust your stereo set for "flat" response. If your tone control is a "High Cut" type, set the control for maximum. This is the starting point to align your system. If possible, transcribe the record the first time it is played. It should have reasonable life, 20 to 30 plays or more, but better safe than sorry.

## WHAT ARE THE WEIRD SIGNALS AT THE START OF THE RECORD?

There are two test patterns that should be used to set up your AC-30. The first is a pattern of "5"s. Set your system up to echo the data from the tape to your terminal (local mode). Play back the tape. You should see a stream of "5"s. If you don't, adjust the tone and volume controls slowly and carefully. The "5"s should play back perfectly. There should be no other characters intermixed with the "5"s.

If you are not able to get the "5"s to play back properly, check your interface circuitry next. If you built the interface shown in Figure 1, adjust the R16 to trim the test pattern.

The second test pattern is a "U" pattern, to check for jitter. If the "5"s worked properly, this should also. If you are not able to get the "5"s to read out, don't go further. Examine your connections, make sure you do not have any ground loops. Make sure you are getting a good clean signal out of the turntable. If you re-recorded the record on a cassette, make sure that you did not overload the cassette recorder when recording. Figure 2 shows a general view of how your system should be hooked up, with the turntable hooked into the AC-30 in place of a cassette machine. If you have arrived this far with flying colors, now is the time to load the program. First check your memory. Make sure all is well before going much further.

On March 26 we received the first sample run of floppy-ROMs. I had problems loading, until I found out someone had borrowed my low memory card. Memory from 0000 to 0FFF is a must! I set up my levels and the test pattern was good. A slightly high boost may be necessary in some systems. If your system has a rumble filter, switch it on. There will be no valid information below 100 Hz, and elimination of these noise components may be helpful.

I.

# Computers

with more  
convenience and power  
for your money  
plus flexible memory  
and  
I/O expansion

(more)



CIRCLE INQUIRY NO. 16

If your record player has a good "scratch" filter, try it too. There is no information above 2400, but response at 2400 should be left as "Flat" as possible. If your scratch filter affects 5000 and above, it may be OK; 10000 and above would be better. Remember that most filters have a finite slope and frequencies 2 to 3 octaves away from the break frequency will be affected by level and phase changes. If you detect errors during program load, turn off the 'scratch' filter first.

### WHAT IF MY TURNTABLE RUNS FAST OR SLOWLY?

Again, the beauty of the "Kansas City" standard comes to the rescue. Very few turntables have speed errors larger than 10%, so there is little reason for concern. If your error is very large, adjust your cassette interface card. I ran my turntable from 10% slow to 10% fast; 10% slow required a slight AC-30 "tweak", while 10% fast did not. Run as close to 33-1/3 as possible on an adjustable speed turntable.

### HOW DO I LOAD THE PROGRAM?

After the test patterns, there is a 20-second space where the 'band' is cut. A string of 'L's follow, to start the loader function in MIKBUG. Place your tone arm down on the record near the end of the test patterns. There is a binary loader program in front of the data, which MIKBUG loads into memory at 1100 HEX. The computer then executes the binary load program, and loads BASIC. Very simple if you have MIKBUG. If you don't, I would recommend either patching the loader program, or re-

2.

## Peripherals

designed for  
the way you use  
your system and,  
for a change, you'd  
want them all at a  
really reasonable  
price

CIRCLE INQUIRY NO. 17

3.

## Software

and superior  
documentation to  
get your system up  
and running fast  
with practical  
applications and a  
well-organized  
user's group

(more)



CIRCLE INQUIRY NO. 18

assembling it as necessary. Figure 4 is a listing of the loader program which was loaded at 1100 HEX. You will note several MIKBUG routines were used. Patch these to fit your operating system. If your turntable has a center depression, place a regular record on the turntable first to support the floppy-ROM.

### WHICH MACHINES CAN USE 4K BASIC?

No 8080 based system will run this program. So IMSAI, Processor Tech, Altair 8080, DG 8080, 6502 and Z80 systems need not try.

The software will run only on a 6800 CPU, but this still becomes a fairly touchy question. I will tell you what I believe: the skill of the individual will tell what is really possible, and what is not. SWTPC 6800 owners should have no trouble at all if 6K of memory is present in the system. The MITS 680 will run the program with modifications. It will also require much more memory than is resident in the basic system. Several articles have been written on expanding the basic chassis. Expand and enjoy. You may need to supply a cassette interface as well. The schematic in Figure 1 should do well. You will need a block of memory from 0000 to at least 1200 HEX.

The Digital Group 6800 system will run the program, but you will need to completely re-do their cassette interface. In addition, you will have to supply several subroutines to operate BASIC. The memory that is standard with the DG should be adequate for 4K BASIC.

The Motorola evaluation module will run this program, but will need more memory. Their new evaluation module with the 'JBUG' monitor will require patching, but older MIKBUG equipped systems will run as is.

I don't have enough information on the Sphere 6800 system to predict success or failure. Operation in that

**INTERFACE**  
MAGAZINE  
Presents

**THE FLOPPY ROM™**  
PROGRAM SHEET

**33 1/3**  
RPM  
MONAURAL

PLACE  
COIN HERE IF  
SOUND SHEET  
SLIPS

**6800 4K BASIC**

Composed by  
**Robert Uiterwyk**

INTERFACE MAG. Magazine VOL. 2, ISSUE 6 page 39A  
MAY, 1977 3177 COPYRIGHT © ALL RIGHTS RESERVED  
MFD. IN U.S.A. BY **EWATONE** DEERFIELD, ILL.  
SOUND SHEETS



**INTERFACE™**

**MAGAZINE**

Presents

**THE FLOPPY ROM™**

May 1977, Vol. 2, Issue 6



**Publishing offices:**

13913 Artesia Blvd., Cerritos, Ca 90701  
Phone: 213-926-6629

**Advertising offices:**

61 South Lake Ave., P.O. Box 4566  
Pasadena, CA 91106  
Phone: 213-795-7002

Manufactured to Interface Age  
specifications by

Eva-Tone Sound sheets  
2051 Waukegan Rd., Deerfield, IL 60015  
Phone: 312-945-5600

system has occurred, but will probably require extensive patching to BASIC.

This program will run in the OSI, but will require much patching. You will have to supply a loader program, and patch the I/O. Also, two routines in MIKBUG that are not in their ROM will have to be patched in. In addition, a cassette interface that is "Kansas City" standard may have to be supplied. Run and Enjoy!

This program should run in a Jupiter II, but I have insufficient data to predict success or failure. Much software may have to be written to drive their CRT interface. Good luck.

Owners of Motorola Exorcisors can run this program with relative ease. Some patches will be required.

The AMI EVK evaluation modules will run this BASIC, but will require patching. It will also need 6K of memory.

Other 6800 systems may be able to run this program. The memory map outlines memory usage. If you have RAM at the appropriate points, the system should go.

#### Memory Map for 4K Basic

0000-00FF	Input buffer and temporary variable storage
0100	Hard starting address of Basic (Cold start — clears program)
0103	Soft starting address of Basic (warm start — saves program)
0105-10FF	Basic Interpreter
1100-11FF	Arithmetic and For-Next stack
A000-A045	Machine stack
A04A-A07F	Index register stack

Note: Binary loader program starts at 1100. It will be cleared by the Basic interpreter when 0100 is executed.

4.

## Self-Instruction Courses

in computer operation and programming to help you get more from your system, whether you're an expert or a novice

CIRCLE INQUIRY NO. 19

5.

## Service

from experts at the factory and through a nationwide network of stores — real help if you need it



CIRCLE INQUIRY NO. 20

### BILOAD PROGRAM

02775	1100		ORG	\$1100
02780	1100	BE A047	LDS	##A047
02790	1103	BD 49	BSR	LOAD
02800	1105	BD 3C	OVER	BSR INPUT
02810	1107	B1 58	CMR A	*'X
02820	1109	26 FA	BNE	OVER
02830	110B	BD 36	BSR	INPUT
02840	110D	B1 31	CMR A	*'1
02850	110F	27 07	BEQ	READ
02860	1111	B1 39	CMR A	*'9
02870	1113	26 F0	BNE	OVER
02880	1115	7E E0E3	JMP	CONTRL
02900	1118	7F A016	READ	ICLR CKSM
02910	111B	BD 26	BSR	INPUT
02920	111D	16	TAB	
02930	111E	5C	INC B	
02940	111F	BD 22	BFX	INPUT
02950	1121	B7 A019	STA A	TW
02960	1124	BD 1D	BSR	INPUT
02970	1126	B7 A01A	STA A	TW+1
02980	1129	FE A019	LIX	TW
03000	112C	BD 15	STORE	BSR INPUT
03010	112E	A7 00	STA A	X
03020	1130	01	NOP	
03040	1131	A1 00	CMR A	X
03050	1133	26 0B	BNE	OUT
03060	1135	0B	INX	
03080	113A	5A	DEC B	
03090	1137	26 F3	BNE	STORE
03100	1139	BD 0B	BSR	INPUT
03110	113B	7C A016	INC	CKSM
03120	113E	27 C5	BEQ	OVER
03130	1140	7E E040	OUT	JMP LOAD19
03140	1143	BD 14	INPUT	BSR INCHP
03150	1145	36	PSH A	
03160	1146	BB A016	ADD A	CKSM
03170	1149	B7 A016	STA A	CKSM
03180	114C	32	PUL A	
03190	114D	39	RTS	

6.

# Assembly Manuals

that are by far the best and most complete in the world.

You'd want illustrated, step-by-step instructions and a "we won't let you fail" pledge.



## CIRCLE INQUIRY NO. 21

03210	114E	B6	11	LOAD	LDA	A	##11
03220	1150	BD	E1D1		JSR		OUTTEE
03230	1153	B6	3C		LDA	A	##3C
03240	1155	B7	8007		STA	A	##0007
03250	1158	39			RTS		
03270	1159	37		INCHP	PSH	B	
03280	115A	BD	E1A5		JSR		SAV

03290	115D	A6	00	IN1	LDA	A	X
03300	115F	2B	FC		BMI		IN1
03320	1161	6F	02		CLR		2>X
03330	1163	BD	E1F3		JSR		DE
03340	1166	BD	E1EF		JSR		DEL
03350	1169	C6	04		LDA	B	#4
03360	116B	E7	02		STA	B	2>X
03370	116D	5B			ASL	B	

03390	116E	BD	E1EF	IN3	JSR		DEL
03400	1171	0D			SEC		
03410	1172	49	00		ROL		X
03420	1174	46			ROR	A	
03430	1175	5A			DEC	B	
03440	1176	26	F6		BNE		IN3

03450	1178	BD	E1EF		JSR		DEL
03460	117B	7E	E1E3		JMP		IOUT2

## RU4K BASIC OBJECTIVE LISTING

```

END OF DUMP? 10FF
0100 - 7E 08 0E 7E 08 15 54 4F 1E 99 99 53 54 45 50 1E
0110 - 88 8B 52 55 4E 1E 08 7B 4C 49 53 54 1E 08 9D 4E
0120 - 45 57 1E 08 0E 50 41 54 1E 08 EE 4C 4F 41 1E 09
0130 - 2B 53 41 56 1E 09 00 47 4F 53 55 42 1E 0A 6A 47
0140 - 4F 54 4F 1E 0A 0C 4F 4E 1E 0A BA 54 48 45 4E 1E
0150 - 0A 39 50 52 49 4E 54 1E 0C 82 4C 45 54 1E 0D 05
0160 - 49 4E 50 55 54 1E 0A D7 49 46 1E 0F 0E 52 45 41
0170 - 44 1E 0C 2B 44 41 54 41 1E 0D F9 52 45 53 54 4F
0180 - 52 45 1E 0C 79 45 4E 44 1E 08 15 52 45 54 53 52
0190 - 4E 1E 0A 92 44 49 4D 1E 0E 21 46 4F 52 1E 0E A2
01A0 - 4E 45 58 54 1E 0F 53 52 45 4D 1E 08 F9 41 50 50
01B0 - 1E 09 2B 53 54 4F 50 1E 0A C6 1E 0D 52 4E 44
01C0 - 28 1E 10 BE 54 41 42 2B 1E 0C 7C 49 4E 54 2B 1E
01D0 - 19 7C 43 4B 52 24 2B 1E 0C BA 43 4B 52 2B 1E 0C
01E0 - BA 41 42 53 2B 1E 10 B5 53 47 4E 2B 1E 10 9A 55
01F0 - 53 45 52 2B 1E 10 6E 13 14 0D 0A 15 52 45 41 44
0200 - 59 1E 20 44 45 4C 1E 10 16 1E 52 45 2D 45 4E 54
0210 - 45 52 1E 45 52 52 4F 52 23 2E 1E 09 4E 4E 20 4C
0220 - 49 4E 45 20 1E CE 02 02 6E 6A 20 07 86 3F BD 48
  
```

```

0230 - BD 03 59 CE 00 8D BD 45 81 18 27 E9 81 0D 27 25
0240 - 81 0F 26 0C 86 5F 8D 30 8C 00 50 27 E9 09 20 E6
0250 - 8C 00 F8 26 05 C6 21 7E 08 47 A7 00 08 20 D7 86
0260 - 23 8D 15 20 CE 86 1E A7 00 DF AE 96 85 26 02 8D
0270 - 31 39 7E E0 BF 7E 0A C8 BD 09 7E 01 BD E1 AC
0280 - 36 20 08 36 8A 80 04 2B 09 BD F2 81 03 26 03 7E
0290 - 08 15 32 39 BD 05 20 0A BD DE 08 A6 00 81 1E 26
02A0 - F7 39 BD 10 CE 02 AC BD F2 BD 1E 39 0B 0A 15 FF
02B0 - FF FF FF 1E DF 3B DE 3A 09 0F 3A 36 96 38 A7
02C0 - 00 94 39 A7 01 32 DE 3B 39 DE 3A EE 00 7C 00 3B
02D0 - 7C 00 3B 39 BD BD 04 4E 9F 2B 35 DE 3A EE 00
02E0 - 20 11 BD 0D BD 04 4E 9F 2B 35 09 09 09 09 09
02F0 - 09 EE 00 C6 05 32 A7 00 08 5A 26 F9 32 32 A7 00
0300 - VE 2B BD C5 39 BD AF 2B 35 20 0A BD A6 BD 04
0310 - 4E 9F 2B AE 00 3A C6 05 DE 5D 32 A7 00 08 5A 26
0320 - F9 32 A7 01 6F 00 9E 2B BD 04 47 BD 9C 39 BD 02
0330 - 75 A6 00 0E 08 BD 02 B4 CE 01 12 DF AB 97 49 DE 08
0340 - 09 09 A6 00 81 1E 26 F9 08 08 08 BD 02 9B BD 09
0350 - 7F 00 40 BD 02 C9 7E 02 94 36 86 20 BD 0D 08 32
0360 - 39 BD 07 40 BD 04 33 25 24 1A A6 01 BD 04 33 25
0370 - 2D BD 07 A5 BD 02 B4 DE 3A BD 04 BA DF 34 BD 02
0380 - C9 EE 00 AD 00 BD 04 47 DE 3A 31 31 31 31 39 08
0390 - 39 BD 04 3B 24 07 81 2B 27 03 09 86 20 08 BD 08
03A0 - 02 B4 DE 2A 9C 46 0D 27 09 E1 00 26 0C A1 01 26
03B0 - 08 0D 63 BD 02 C9 0A 39 0A 39 0A 81 81 81 32 27
03C0 - 05 BD 04 5D 20 DE EE 04 2A BD 02 83 BD 92 2B
03D0 - 01 39 36 25 31 DF 34 DE 63 81 2B 27 15 08 DF
03E0 - 63 DE 5D 96 63 A7 00 96 64 A7 01 BD 5A 32 DE 34
03F0 - 0C 39 BD 0D FF 24 0A BD 74 20 01 5F 37 BD 8E 17
0400 - 33 BD 0E 75 20 BF 34 DE 63 E7 0D 07 01 81 2B
0410 - 26 19 C6 0A E7 02 E7 03 BD 0D FF 25 03 5F E7 03
0420 - A6 02 BD 0E 5D 63 03 27 D2 20 CC BD 30 DF 46 DE
0430 - 63 20 AA 81 41 2B 0C 81 5A 2F 0A 81 30 2B 04 81
0440 - 3F 2F 02 0D 39 0C 39 0E 5D BD 13 DF 5D 39 DE 5D
0450 - 8D 03 2F 07 09 09 09 09 09 09 09 39 08 08 08
0460 - 08 08 08 08 08 9C 44 2B 03 7E 0A 08 39 BD 02 B4
0470 - BD DC A6 06 81 04 2F 05 C6 01 7E 08 47 4F 5F 6D
0480 - 06 23 19 58 49 D7 52 97 51 58 49 58 49 DB 52 99
0490 - 51 EB 00 89 00 0D 05 5C 6A 06 20 E3 4D 26 D9 BD
04A0 - 02 C9 39 BD 07 40 BD 03 CA 25 04 BD 03 0C 39 BD
04B0 - 08 3B 25 01 39 81 2B 26 11 08 BD 33 BD 07 40 24
04C0 - 02 26 02 08 39 C6 13 7E 08 47 C6 06 20 F9 BD D3
04D0 - BD 07 60 81 2A 26 08 08 BD 07 60 BD C6 BD 06 E6
04E0 - 20 EE 81 2F 26 08 08 BD BA BD 06 4E 20 E2 39 BD
04F0 - 07 60 81 2D 26 07 08 BD 05 BD 2B 2D 07 81 2B 26
0500 - 01 08 BD CA BD 07 60 81 2B 26 08 08 BD CO BD 04
0510 - 07 20 F1 81 2D 26 08 08 BD BA BD 06 04 20 E5 39
0520 - BD 02 B4 BD 04 5E 20 60 37 02 B4 DE 5D 09 09 20
0530 - 06 BD 02 B4 BD 04 60 37 02 B4 DE 5D 09 09 20
0540 - 00 09 5A 26 F6 BA 0F 02 C9 33 32 39 36 BD 0A A6
0550 - A7 00 09 5A 26 F5 BD 02 C9 33 32 39 36 BD 0A A6
  
```

...but you don't need to design your own because our systems\* are coming this Fall:

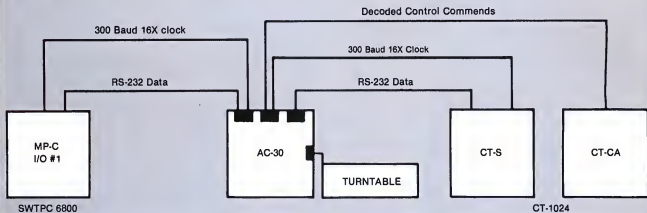
# They're the ones you've been waiting for.

\*The Heath Co./Benton/Harbin, Inc.

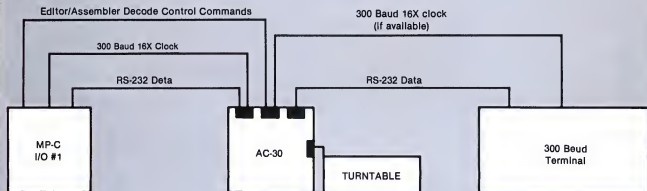
0560 - 00 84 0F A7 00 32 39 36 37 DF 57 C6 04 DE 57 BD  
0570 - 04 60 88 00 86 05 09 69 00 46 26 FA 56 2E EE 33  
0580 - 32 39 0F 07 57 86 06 84 07 2F 53 C6 04 DE 57  
0590 - 44 00 86 05 08 06 46 26 FA 56 2F 53 C6 04 DE 57  
0600 - 00 98 53 A7 00 33 32 39 02 84 BD 04 4E 7F 00  
0610 - 56 BD 00 BC 24 19 A6 00 2A 08 97 56 BD 05 31 86  
0620 - 0F 04 A7 00 A6 00 26 08 01 61 A6 06 20 F6 6F  
0630 - 06 45 05 A6 06 06 15 15 37 C6 05 86 A7 0D 9D  
0640 - 08 5A 26 FA 86 A7 01 BD 04 57 33 20 D1 81 9D A6  
0650 - 2E 03 03 08 0F 7D 00 56 27 03 BD 05 31 BD 04 47  
0660 - 8D 02 C9 39 BD 05 28 BD 02 84 BD 04 4E BD 08 BC  
0670 - 24 28 BD 05 82 6C 06 04 4E BD 01 BC 24 11 BD  
0680 - 05 82 6C 06 04 4E BD 01 BC 24 11 BD  
0690 - 8D 0C BD 23 BD 04 BD 05 08 BD 02 C9 39 DE 5D  
0700 - 37 36 C6 07 A6 00 36 A6 07 A7 00 32 A7 07 08 5A  
0710 - 26 F2 DE 5D 32 33 39 36 37 DE 56 C6 06 0C A6 05  
0720 - 06 00 A9 0C 1A 07 05 09 5A 2F 53 DE 5D 33 32 39 BD 02  
0730 - 84 BD 08 0F BD 04 06 04 00 25 0C 06 06 7E 08  
0740 - 47 40 96 BD 38 05 05 82 BD 05 20 84 0F 5F 5D 08  
0750 - C6 6D 00 2A F9 5A BD 05 20 BD 0C 8D 05 20 BD 04  
0760 - 5E BD 04 5E BD 05 67 EB 05 E7 05 DE 5D 05 67  
0770 - 46 26 DA BD 04 47 BD 86 7C 00 50 5D 20 BD 05 82  
0780 - 4F 6D 00 2A 05 BD 05 31 86 BD 04 4E 6D 00 2A  
0790 - 0D 05 BD 05 31 86 BD 07 4A A6 0A 08 05 28 05 B6 78  
0800 - 24 01 40 97 50 39 BD 02 84 BD 04 4E 8D CF BF 59  
0810 - BD 04 47 BD 06 3E BD 08 BF 0A 09 DE 5E 6A 00 BD  
0820 - 05 5C 5D 27 06 BD 06 57 5A 20 F7 DE 5D 04 04 5E  
0830 - BD 05 82 4A 26 08 00 20 F9 5D 08 3B 24 C6  
0840 - 02 BD 04 05 08 05 AB 70 00 4A 03 BD 05 28 BD 02  
0850 - C9 39 36 32 6A 33 00 31 32 30 25 1E DE 2E 96 30  
0860 - D6 31 E0 01 A2 00 25 14 96 03 5D 27 10 08 08 A6  
0870 - 00 81 1E 26 F9 08 0C 2A 26 E4 DE 2A 0D BF 2C 39  
0880 - 4A 00 81 29 26 03 06 20 F9 5D 08 3B 24 C6  
0890 - 07 78 4E 47 BD AC BD 04 4E A6 04 07 08 08  
0900 - EE 86 05 10 4D 27 06 BD 05 82 4A 20 F7 A6 01 97  
0910 - 30 A6 02 97 31 DE AC 0C 39 DE 3A A6 00 86 01 1E  
0920 - 26 F9 DF 36 39 DF AC 9F 28 CE 01 BC 12 12 AC  
0930 - 9F 28 CE 01 05 20 09 08 0C 01 BC 12 12 AC  
0940 - 9E AC 34 08 BD 01 20 0A FB E4 0C 01 1F 28 11  
0950 - 27 F1 08 8C 01 8A 27 17 8C 01 F4 27 18 E6 00 31  
0960 - 1E 26 EF 08 08 20 09 08 9F AC 9F 3A 9E 28 39 C9  
0970 - 28 CE 01 B8 39 78 08 28 CE 12 00 DF 2E 7F 2A DF  
0980 - 4E 4F 97 32 7F 08 0C 4E 05 CE 7F 2A DF 2A DF  
0990 - 45 BD E5 20 61 8E A0 45 CE 00 7F 2F 07 00 85  
1000 - CE 01 F7 BD 02 94 7F 00 4D 02 5F CE 00 75 DF  
1010 - 07 6D BD 04 38 25 05 80 09 59 20 1A 81 1E 27 L6  
1020 - BD 07 87 EE 06 06 0E 8E A0 45 BD 02 A2 CE 02 13  
1030 - BD 02 98 27 08 0C 4E 26 F9 5D 08 3B 24 C6  
1040 - 98 DE 58 96 3A 2E CE 00 4F 00 61 01 BD 02  
1050 - 75 BD 02 A2 2F 2E 2F 2E 2F 3C 36 CE 00 75 DF  
1060 - 65 CE 11 80 DF 5E 2A DF 46 4F 09 08 A7 00 9C  
1070 - 44 27 07 A6 00 27 F5 09 4D 7A 7E 0A 10 CE 02 07  
1080 - BD 02 98 27 08 0C 4E 26 F9 5D 08 3B 24 C6  
1090 - 34 BD 07 3C DF 24 3A BD 07 60 81 1F 27 04 08  
1100 - BD 07 6A CF 06 01 BB 31 2A 1F 31 99 30 19 97 30  
1110 - BD 07 3C DF 24 20 06 DE 19 DF 2C DE 2E 9C 2C 27  
1120 - 0A 9C 2A 27 26 BD 03 25 08 20 F2 7E 08 09 27  
1130 - 99 CE 0A 10 FF 0A 46 8E A0 40 8F A0 8F 5E 0E E3  
1140 - DE 2E 8A 12 BD 02 78 BD 3A BD 38 BD 41 9C 2A 07  
1150 - BD 06 02 BD 02 78 BD 03 2E 08 BD 29 20 EF 86 03  
1160 - BD 02 78 BD 29 78 05 18 BD 07 F8 86 11 97 85 BD  
1170 - 02 78 BD 02 78 BD 01 26 F9 BD 02 33 CE 00 80 BD  
1180 - 1B 0F 08 05 4E 26 F9 5D 2A F9 C6 02  
1190 - 8A FF BD 02 78 5A 26 F9 BD 07 6A BD 07 32 2A  
1200 - 13 BE AC BD 07 60 81 1F 27 01 2E 2C 9C 2A 27 1C  
1210 - BD 48 20 17 AE BD 07 60 81 1E 26 A6 DE 2A 9C  
1220 - 2E 27 08 BD 0F 20 0A BD 08 BD 2F 39 BD 2C 38 20  
1230 - F2 32 20 F7 28 BD 2E 9E 29 08 BD 3A 34 5E 00  
1240 - 34 08 81 1E 26 FB 9F 2A 9F 46 35 DE 2C 9C 2A 27  
1250 - 06 32 A7 00 80 20 F6 9E 28 39 DE AC BD 07 87 9F  
1260 - 28 DF 48 DE 2A DF 20 D6 A0 0D AC 0A DB 28 B6  
1270 - 00 99 2A 91 44 22 34 D7 28 9A 2A DE 4B 46 35  
1280 - 2E 2C 9C 2A 27 08 0C 4E 26 F9 5D 08 3B 24 C6  
1290 - A7 00 80 96 31 A2 00 08 96 49 A7 00 08 9E AC 3A  
1300 - 32 07 00 08 81 1E 26 FB 9E 28 39 C6 14 7E 08 A7  
1310 - CE 01 12 DF 8C 01 12 DF 8C 01 12 DF 8C 01 12 DF  
1320 - 26 03 7E 08 15 70 36 27 FB 08 08 A6 00 BD 04  
1330 - 34 97 4E 48 DE 48 DE 4F 08 3A BD 07 60 BD 04  
1340 - 3B 24 7E 0F F5 C6 20 7E 08 07 6A BD 04 EF  
1350 - BD 04 6D 5D 27 F0 5A BD 7 55 BD 07 5E 00 8C 0A  
1360 - 8C 27 2C 8C 0A 6D 27 05 20 DE 7F 00 55 DE 3A BD  
1370 - 07 99 99 65 8C 0A 6D 27 05 20 DE 7F 00 55 DE 3A BD  
1380 - A7 00 80 96 31 A2 00 08 96 49 A7 00 08 9E AC 3A  
1390 - 34 BD 07 6A 7A 00 55 28 BD 07 60 81 2C 26 A6  
1400 - 08 20 EE BD 07 32 2A 05 C6 07 7E 08 47 DF 3A 7E  
1410 - 0A 10 DE 65 8C 01 75 26 05 C6 10 7E 08 47 09 09  
1420 - DF 65 EE 00 20 08 05 9A 3A 26 05 C6 10 7E 08 47  
1430 - 36 BD 02 7E 08 15 9A 3A 26 05 C6 10 7E 08 47  
1440 - 8D 02 CE 00 8D BF AC 3A BD 03 CA 25 31 DF  
1450 - 34 DE AC BD 38 24 12 81 1E 27 06 CE 02 0A BD 02  
1460 - 9A BD 02 CE 00 8D BD 00 EA BD 02 E2 BD 07 60 81  
1470 - 2C 26 A6 00 81 1E 26 BD 07 60 81 2C 26 A6  
1480 - 09 7F 00 40 81 1E 26 2C 7E 0D F9 C6 03 7E 08 47

0B30 - BD 07 60 97 4A 08 B1 2D 27 04 09 7F 00 4A 4F 97  
0B40 - AC 97 4D 97 4E BD 0B 0F D6 5D 27 06 D6 5E 97 27  
0B50 - C6 05 BD 60 BD 0A 38 24 08 B1 2E 26 05 97 BD  
0B60 - 08 20 00 3F 09 08 06 04 00 04 00 04 00 04  
0B70 - 26 0F 0D AC AC 26 0C 7D 00 4D 27 EA 7A 00 4B 20  
0B80 - E5 97 AC BD 02 84 DE 26 5D 27 16 7A 00 4E 26 08  
0B90 - AB 00 47 00 08 5A 20 06 48 48 48 A7 00 73 00  
0BA0 - E4 DE 2F 7D 4D 26 03 7C 00 48 BD 02 C9 20 B6  
0BB0 - 7D 00 4D 26 08 B1 2F 24 04 97 4D 20 A9 5F 81 45  
0BC0 - 26 14 0A 8A 00 81 2D 27 09 B1 2B 26 01 08 BD 3A  
0BD0 - 20 04 08 A6 00 31 20 96 48 18 BD 02 84 DE 5D A7 06  
0BE0 - BD 04 47 BD 02 C9 7D 00 4A 27 03 BD 05 28 0C 39  
0BF0 - BD 02 84 37 C6 07 DE 5D 6F 08 08 5A 26 FA 7F 00  
0C00 - 4B 33 02 C9 39 0A 00 04 00 04 3E 24 05 0E 7F  
0C10 - 08 47 BD 30 16 08 A6 00 4D 0A 3B 25 08 17 58  
0C20 - 58 17 16 A6 00 30 30 18 16 08 39 3D 34 BD 03 BD  
0C30 - 25 3F BF 34 DE 3C 9C 2E 27 1E BD 08 00 20 22 09  
0C40 - A6 00 81 27 05 C6 19 7E 08 47 9C 2A 27 F7 A6  
0C50 - 00 08 B1 1E 2F 5A A6 02 81 79 24 08 08 08 20  
0C60 - 0F BD 02 E2 08 BF 3C 34 BD 07 60 08 B1 2C 27  
0C70 - 8C 09 B1 1E 26 7D 00 0F 09 DE 2E DF 3C DE 3A 7E  
0C80 - 0F F9 DE 34 BD 07 60 B1 22 26 14 08 A6 00 08 B1  
0C90 - 22 27 4A B1 1E 26 0A C6 04 20 1C BD 06 20 BD 81  
0CA0 - 1E 26 35 09 A6 00 08 B1 3B 27 06 BD 02 7E 00  
0CB0 - 4A 08 BF 36 7E 0A 10 7E 08 47 DE 34 BD 04 6D 17  
0CC0 - BD 49 BE A0 45 20 16 DE 3A BD 04 6D 00 20 23 F2  
0CD0 - BD 03 59 5A 26 FA 20 EA 8A 0A EF 8D 48 BD 07 60  
0CE0 - B1 2C 26 08 08 96 A0 16 C6 14 20 17 0A BD 03 59  
0CF0 - 0F 37 3B 26 04 08 00 00 00 00 00 00 00 00 00  
0D00 - 20 85 B6 2E 20 05 4F 08 BF 8B 30 36 BD 02 78 32  
0D10 - 37 D6 40 5C 5C 10 20 23 0C C1 3F 27 04 81 20 26 0A  
0D20 - 0E 02 62 5F 07 40 33 39 BD 02 84 BD 04 4E 4F 97  
0D30 - 4D 00 26 08 BD 08 BF 02 C9 7E 03 59 6D 00 2A  
0D40 - 0F 37 3B 26 04 08 00 00 00 00 00 00 00 00 00  
0D50 - 2D 2B 4D 2E 10 BD AF BD A9 97 48 6D 0A 2A 1C BD  
0D60 - 65 0C 06 20 F6 7D 00 4D 26 11 A6 00 BD 99 8D 05  
0D70 - 5C 6A 06 25 F5 BD 45 2A BE BD 87 BD 30 20 8B A6  
0D80 - 0A 9C 34 08 BD 05 31 86 BD 05 31 86 BD 05 31 86  
0D90 - E6 0A 3A 2A 0A 00 08 B1 3B 27 06 BD 02 7E 00  
0DA0 - F8 4A C6 0A BD 0D 07 17 BD 02 70 8A BD 01 24  
0DB0 - 0A C8 0A BD 0D 07 BD 05 5C 20 F2 39 BD 02 84 B6  
0DC0 - 5D 37 C6 06 00 20 26 07 08 5A 26 FB 0C 20 01 0D  
0DD0 - F9 C9 33 39 36 BD 08 03 CA 24 05 0C 12 7E 8D  
0DE0 - F8 BD 07 60 08 B1 3D 27 03 0A 04 00 04 00 04  
0DF0 - B1 1E 2F 5A BD 02 E2 00 00 00 07 99 7E 0A 10 BD  
0F00 - 02 B4 BE 3A BD 0A EF 8D B1 2C 27 08 B1 29 26 1A  
0F10 - DF 3A BD 02 C9 0C 63 BD 0A 8A BF 34 BD 02 C9 0D  
0F20 - 0A 97 4D 97 4E BD 0B 0F D6 5D 27 06 D6 5E 97 27  
0F30 - 28 2F 47 BF 34 DE 3C 9C 2E 27 1E BD 08 00 20 22 09  
0F40 - 0A 6D 20 01 5F 07 40 33 39 BD 02 84 BD 04 4E 4F 97  
0F50 - 3A BD 07 60 08 B1 3D 27 03 0A 04 00 04 00 04  
0F60 - E6 03 BD 11 BD 0A 5F DE 46 BD 02 C9 96 46 07 A4  
0F70 - 0A 97 4D 97 4E BD 0B 0F D6 5D 27 06 D6 5E 97 27  
0F80 - F7 E1 03 2D F3 3A A6 02 07 51 5D 27 00 5A 27 0A  
0F90 - 96 51 BD 04 5F 4A 26 F0 2F 32 BD 04 5F 4A 26  
0FA0 - FA 39 DE 34 BD 03 CA 24 03 7E 08 0D BF 3A DE 5D  
0FB0 - 0A 44 55 A6 06 0A 0E C1 11 80 9C 5F 27 0F A1 00  
0FC0 - 26 0A E1 01 27 07 BD 0A 5D 20 EF DE 5F 8C 12 00  
0FD0 - 26 05 C6 10 7E 08 47 A7 00 08 9E 07 00 DF 5F 5E  
0FE0 - 34 BD 07 60 08 B1 3D 27 03 0A 04 00 04 00 04  
0FF0 - 02 E2 BD 07 AE 8C 01 09 26 EF DE 34 BD 04 EF DF  
1000 - 34 BF 5D 02 DE 0A BD 0A 5F DF 5F 34 BD 07 AE  
1010 - 08 01 26 09 DE 0A 38 24 08 B1 2F 0A 00 04 00 04  
1020 - BD 0F 0A 06 A7 00 A7 00 0A BD 0A 47 DE 5F BD 0D  
1030 - 1A BD 0A 0A 5F DF 5E 3A BD 07 60 81 1E 26 A6 DF  
1040 - DF 36 5F 5E 3A BD 07 60 81 1E 26 A6 DF 36 5F 5E  
1050 - 7E 0A 10 DE 3A BD 03 CA 24 03 7E 08 0D BF 3A DE 5D  
1060 - B1 1E 26 08 08 B6 08 16 0A 0E A4 00 E4 0E 5A  
1070 - 8C 11 BD 27 66 DF 5F 8C 11 80 27 58 BD 0A 5A BD  
1080 - 0A 54 01 00 2E 6F 01 01 26 BF 8D 61 EE 00 BD 03  
1090 - 05 DE 61 BD 0A 5D 86 02 6D 00 2A 02 08 03 97 4F  
1100 - BD 03 05 BD 06 07 0C 06 4F BD 02 84 BD 04 DE  
1110 - B1 1E 26 08 08 B6 08 16 0A 0E A4 00 E4 0E 5A  
1120 - 0A 10 CE 00 6F BD 03 DE 61 EE 00 BD 02 84 BD  
1130 - 61 EE 0E DF 36 20 E8 B6 18 20 02 C6 17 7E 08 47  
1140 - 34 BD 0A EF BD 17 97 4F 8D 0A EF DF 34 BD 4A  
1150 - 24 03 0D 09 F9 DE 3A BD 87 8F 8D 00 08 00 00  
1160 - 00 81 3D 26 03 B6 00 39 EA 00 81 35 26 13 C1  
1170 - 3C 26 0A 08 B6 02 39 C1 3E 26 0A 08 B6 03 39 B6  
1180 - 01 39 31 3E 27 05 C6 4E 7E 08 47 C1 3D 30 26 0A  
1190 - 8A 05 39 C1 3E 27 05 C6 4E 7E 08 47 C1 3D 30 26 0A  
1200 - 24 03 0D 09 F9 DE 3A BD 87 8F 8D 00 08 00 00  
1210 - 20 4E 00 27 16 20 12 28 12 02 00 2E 0E 2E 0F 4  
1220 - 26 0A 02 06 27 0A 28 02 0A 02 0D 39 0C 39 BD 0A  
1230 - 0E 02 84 DE 67 AD 00 08 02 C9 39 24 0A 4E C6  
1240 - 09 0E 06 5D 2F 08 03 82 AC 6A 5A 20 F5 6F 05  
1250 - 08 0A 05 05 05 05 05 05 05 05 05 05 05 05 05  
1260 - 13 97 4A 08 0F 86 A1 07 A0 07 A6 7D 00 4A 2A  
1270 - 03 05 31 39 BD 0A 4E 6D 00 2A 07 20 F3 BD 0A  
1280 - 4E BD 0C 24 05 BD 0A 47 20 06 CE 00 69 BD 03  
1290 - 05 CE 10 FC BD 03 05 BD 06 E6 BD 0A 8D 05 3C  
1300 - A6 01 19 09 08 02 23 A7 00 0A 00 0A 00 0A 00  
1310 - 05 AB 0E 00 69 BD 02 DA 39 08 37 25 41 69 00

SWTPC 6800 Computer System/AC-30/CT-1024 Terminal System



SWTPC 6800 Computer System/AC-30/NON-CT-1024 300 Baud Terminal System



SWTPC 6800 Computer System/AC-30/NON-300 Baud Terminal System

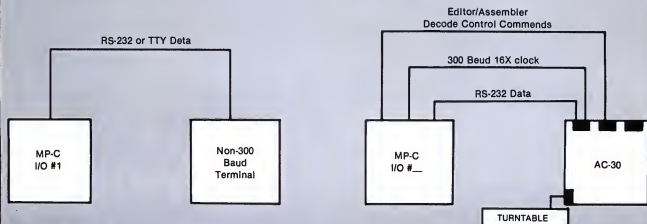


Figure 2. Interconnection Block Diagrams



# Peripheral Vision impacts your computer.



**WITH A  
FULL-SIZE,  
LOW-COST  
IMPACT  
PRINTER.**

Until now, the hobbyist and small businessman have had one major problem in assembling a reasonably priced microprocessor system with the capabilities found in the more costly computers. It was impossible to find a high-quality, high-output printer for hard copy needs at an affordable price.

Peripheral Vision has come up with a solution.

We are offering a full-size impact printer designed for microprocessors—and it comes with a mini price. Kit prices start as low as \$495 for the printer and interface card. And that won't impact your pocketbook.

Peripheral Vision's printer is loaded with capabilities. Take a look:

- It's fast—120 characters per second
- 96 characters per line, 12 characters per inch horizontal, 6 lines per inch
- Makes up to 4 copies simultaneously
- Character set and pitch variable under software control
- 5 x 7 character matrix
- Ribbon has built-in re-inkers for a life of 10,000,000 characters
- Paper can be either a standard 8½-inch roll, fanfold or cut page
- Interfaces to 8-bit parallel ports

Just remember, Peripheral Vision is committed to helping you get along with your computer. The new printer we are offering is another example. It is high quality, low in cost and will definitely impact your system.

Write or call now to find out how to impact your computer.

**PERIPHERAL  
VISION** INC.

P.O. Box 6267 Denver, Colorado 80206 (303) 777-4292

# See Sol Systems at your dealer

## ARIZONA

Byte Shop Tempe  
813 N. Scottsdale Rd.  
Tempe, AZ 85281

Byte Shop Phoenix  
12654 N. 28th Dr.  
Phoenix, AZ 85029

Byte Shop Tucson  
2612 E. Broadway  
Tucson, AZ 85716

## CALIFORNIA

Bits 'N Bytes  
679 S. State College Blvd.  
Fullerton, CA 92631

The Byte Shop  
1514 University Ave.  
Berkeley, CA 94703

The Byte Shop  
2626 Union Ave.  
Campbell, CA 95124

Byte Shop Computer Store  
6041 Greenback Lane  
Citrus Heights, CA 95610

Computer Center  
1913 Harbor Blvd.  
Costa Mesa, CA 92627

The Byte Shop  
16508 Hawthorne Blvd.  
Lawndale, CA 90260

The Byte Shop  
1063 El Camino Real  
Mountain View, CA 94040

The Computer Mart  
624 West Katella #10  
Orange, CA 92667

The Byte Shop  
2227 El Camino Real  
Palo Alto, CA 94306

Byte Shop  
496 South Lake Ave.  
Pasadena, CA 91101

The Computer Store  
of San Francisco  
1093 Mission Street  
San Francisco, CA 94103

Byte Shop  
321 Pacific Ave.  
San Francisco, CA 94111

The Computer Room  
124H Blossom Hill Rd.  
San Jose, CA 95123

The Byte Shop  
509 Francisco Blvd.  
San Rafael, CA 94901

The Byte Shop  
3400 El Camino Real  
Santa Clara, CA 95051

The Byte Shop  
2989 North Main St.  
Walnut Creek, CA 94596

Byte Shop  
14300 Beach Blvd.  
Westminster, CA 92683

Recreational  
Computer Centers  
1324 South Mary Ave.  
Sunnyvale, CA 94087

Byte Shop of Tarzana  
18424 Ventura Blvd.  
Tarzana, CA 91356

Digital-Deli  
80 West El Camino Real  
Mountain View, CA 94040

## COLORADO

Byte Shop  
2040 30th St.  
Boulder, CO 80301

## FLORIDA

Byte Shop of Miami  
7825 Bird Road  
Miami, FL 33155

Microcomputer Systems Inc.  
144 So. Dale Mabry Hwy.  
Tampa, FL 33609

Sunny Computer Stores  
University Shopping Center  
1238A S. Dixie Hwy.  
Coral Gables, FL 33146

Delta Electronics  
2000 U.S. Highway 441 East  
Leesburg, FL 32748

## GEORGIA

Atlanta Computer Mart  
5091-B Buford Hwy.  
Atlanta, GA 30340

## ILLINOIS

The Numbers Racket  
518 East Green St.  
Champaign, IL 61820

itty bitty machine co.  
1316 Chicago Ave.  
Evanston, IL 60201

itty bitty machine co.  
42 West Roosevelt  
Lombard, IL 60148

## INDIANA

The Data Domain  
406 So. College Ave.  
Bloomington, IN 47401

The Data Domain  
219 West Columbia  
West Lafayette, IN 47905

The Data Domain  
7027 N. Michigan Rd.  
Indianapolis, IN 46268

The Byte Shop  
5947 East 82nd St.  
Indianapolis, IN 46250

## KENTUCKY

The Data Domain  
3028 Hunsinger Lane  
Louisville, KY 40220

## MICHIGAN

The Computer Store  
of Ann Arbor  
310 East Washington  
Ann Arbor, MI 48104

General Computer Store  
2011 Livernois  
Troy, MI 48064

Computer Mart of Royal Oak  
1800 W. 14 Mile Rd.  
Royal Oak, MI 48073

## NEW JERSEY

The Computer Mart  
of New Jersey  
501 Route 27  
Iselin, NJ 08830

Hoboken Computer Works  
No. 20 Hudson Place  
Hoboken, NJ 07030

## NEW YORK

Audio Design Electronics  
487 Broadway, Ste. 512  
New York, NY 10013

The Computer Corner  
200 Hamilton Ave.  
White Plains, NY 10601

The Computer Mart  
of Long Island  
2072 Front Street  
East Meadow, L.I. NY 11554

The Computer Mart  
of New York  
314 Fifth Ave.  
New York, NY 10001

Synchro Sound Enterprises  
193-25 Jamaica Ave.  
Hollis, NY 11423

The Computer Shoppe  
444 Middle Country Rd.  
Middle Island, NY 11953

## OREGON

The Real Oregon  
Computer Co.  
205 West 10th Ave.  
Eugene, OR 97401

Byte Shop Computer Store  
2033 S. W. 4th Ave.  
Portland, OR 97201

Byte Shop Computer Store  
3482 S. W. Cedar Hills Blvd.  
Beaverton, OR 97005

## OKLAHOMA

High Technology  
1020 West Wilshire Blvd.  
Oklahoma City, OK 73116

## RHODE ISLAND

Computer Power, Inc.  
M24 Airport Mall  
1800 Post Rd.  
Warwick, RI 02886

## SOUTH CAROLINA

Byte Shop  
2018 Green Street  
Columbia, SC 29205

## TENNESSEE

Microproducts & Systems  
2307 E. Center St.  
Kingsport, TN 37664

## TEXAS

The Micro Store  
634 So. Central Expressway  
Richardson, TX 75080

Computertex  
2300 Richmond Ave.  
Houston, TX 77098

Interactive Computers  
7646 Dashwood Rd.  
Houston, TX 77036

Byte Shop  
3211 Fondren  
Houston, TX 77063

## WASHINGTON

Byte Shop Computer Store  
14701 N.E. 20th Ave.  
Bellevue, WA 98007

The Retail Computer Store  
410 N.E. 72nd  
Seattle, WA 98115

WASHINGTON, D.C. Area  
Media Reactions Inc.  
11303 South Shore Dr.  
Reston, VA 22090

## WISCONSIN

The Milwaukee  
Computer Store  
6916 W. North Ave.  
Milwaukee, WI 53213

## CANADA

The Computer Place  
186 Queen St. West  
Toronto, Ontario M5V 1Z1

Trintronics  
160 Elgin St.  
Place Bell Canada  
Ottawa, Ontario K2P 2C4

First Canadian  
Computer Store Ltd.  
44 Eglinton Ave. West  
Toronto, Ontario M4R 1A1

Pacific Computer Store  
4509-11 Rupert St.  
Vancouver, B.C. V5R 2J4



Processor Technology, 6200G Hollis Street, Emeryville, CA 94608, Phone (415) 652-8080



# The Small Computer

Twenty-five years ago a computer as powerful as the new Processor Technology Sol-20 priced out at a cool million.

Now for only \$995 in kit form or \$1495 fully assembled and tested you can have your own small computer with perhaps even more power. It comes in a package about the size of a typewriter. And there's nothing like it on the market today. Not from IBM, Burroughs, DEC, HP or anybody else!

## It fills a new role

If you're an engineer, scientist or businessman, the Sol-20 can help you solve many or all of your design problems, help you quantify research, and handle the books too. For not much more than the price of a good calculator, you can have high level computer power.

## Use it in the office, lab, plant or home

Sol-20 is a smart terminal for distributed processing. Sol-20 is a stand alone computer for data collection, handling and analysis. Sol-20 is a text editor. In fact, Sol-20 is the key element of a full fledged computer system including hardware, software and peripheral gear. It's a computer system with a keyboard, extra memory, I/O interfaces, factory backup, service notes, users group.

It's a computer you can take home after hours to play or create sophisticated games, do your personal books and taxes, and a whole host of other tasks.

Those of you who are familiar with small computers will recognize what an advance the Sol-20 is.

Sol-20 offers all these features as standard:

8080 microprocessor — 1024 character video display circuitry — control PROM memory — 1024 words of static low-power RAM — 1024 words of preprogrammed PROM — built-in cassette interface capable of controlling two recorders at 1200 bits per second — both parallel and serial standardized interface connectors — a complete power supply including ultra quiet fan — a beautiful case with solid walnut sides — software which includes a preprogrammed PROM personality module and a data cassette with BASIC-5 language plus two sophisticated computer video games — the ability to work with all S-100 bus products.

## Full expansion capability

Tailor the Sol-20 system to your applications with our complete line of peripheral products. These include the video monitor, audio cassette and digital tape systems, dual floppy disc system, expansion memories, and interfaces.

## Write for our new 22 page catalog.

## Get all the details.

Processor Technology, Box G, 6200 Hollis St., Emeryville, CA 94608. (415) 652-8080.



# Robert 4K

by William W. Turner

## BASIC PROGRAM FORMAT

### FOREWORD

This article is one of a series covering the 6800 microcomputer 4K BASIC Interpreter program developed by Robert Uiterwyk of MicroComputer Systems, Inc. A copy of this program is included in this issue in the form of an object-coded floppy platter. This article covers the 4K BASIC Interpreter grammar and its companion piece by William Blomgren covers the theme of how to load this BASIC Interpreter program into your 6800 microcomputer.

### INTRODUCTION

The following Table 1, SUMMARY OF BASIC FEATURES, explains the characteristics of the 6800 4K BASIC Interpreter program. For convenience Robert Uiterwyk's 4K BASIC also carries the mnemonic name RU4KBASIC.

TABLE 1 SUMMARY of BASIC FEATURES

COMMANDS	STATEMENTS		FUNCTIONS
LIST	REM	END	ABS
RUN	DIM	GOTO*	INT
NEW	DATA	ON...GOTO*	RND
SAVE	READ	ON...GOSUB*	SGN
LOAD	RESTORE	IF...THEN*	CHR
PATCH	LET*	INPUT	USER
	FOR	PRINT*	TAB
	NEXT	PATCH*	
	STOP	RETURN	
	GOSUB*		

\*Flags statements that may be used in the direct mode (No statement numbers)

#### MATH OPERATORS      RELATIONAL OPERATORS

- Unary negation	= Equal
* Multiplication	<> NOT Equal
/ Division	< Less than
+ Addition	> Greater than
- Subtraction	<= Less than or Equal
	>= Greater than or Equal

Line numbers may be from 0001 to 9999

Variables      Simple variables: Single alphabetic or  
Single alphabetic and  
a single digit  
Single alphabetic

Arrays:  
Backspace      Control-O  
Line delete      Control-X  
Panic Button      Control-C should bring Basic back to the  
READY mode regardless of what the  
BASIC user program is doing.

A BASIC program is comprised of programming statements. These statements tell the computer in a step-by-step sequence how to perform a particular task. The computer has no intelligence of its own, and only understands what it has been programmed to do. The BASIC language has some simple but exacting rules on how to instruct a computer how to do a particular task. For instance, the format of a BASIC programming statement is always a statement number, followed by the statement body, and terminated by a carriage return. The statement body always starts with a keyword that identifies the type of statement.

Statements need not be entered in numerical order, because the BASIC interpreter will automatically sort the statements in ascending order by line numbers. The statement number is also used for reference purposes, as will be seen when discussing the GOTO, GOSUB and IF statements. All line numbers must be between 1 and 9999, and zero may not be used. A programming statement may contain no more than 72 characters including blanks. Unless within a character string and enclosed by quotation marks ("), blanks are *not* processed by BASIC, and their use is optional. With blanks, the statement is more readable, as can be seen in Figure 1, but will require a slightly longer time to process. In addition typing blanks in the statements will require more memory for the storage of the program. Keep in mind, though, that program readability is very important; for if you cannot read it, you cannot modify or fix it! The only place in BASIC that blanks may not be used at all, is inside the various keywords and inside numbers. "12 34" is *NOT* the same as "1234".

Programming Statement	Memory required
110 LET A = B + (3.5*5E2)	23 Bytes
110LETA = B + (3.5*5E2)	16 Bytes

Figure 1 Statements with and without imbedded blanks.

In any one program, a line number may be used only once. A previously entered line may be changed by entering the same line number along with the desired new statement. Typing just a line number followed by a carriage return will delete that line.

It is strongly suggested that you use line numbers which are at least ten numbers apart. This will make it easier to add in statements between the original statements in case of omission, or if you desire to add additional features to an existing program. If you do wish to insert a statement between two others, you need only type a line number that falls between the other two. For example consider the following original BASIC program:

# Uiterwyk's BASIC

```
180 LET P = A * A * 3.14
185 PRINT
```

in which it is desired to insert the following addition program statement

```
183 REM INSERT THIS LINE
with the resulting program becoming:
180 LET P = A * A * 3.14
183 REM INSERT THIS LINE
185 PRINT
```

If it is desired to replace a statement, a new statement is typed that has the same line number as the one to be replaced. For example, typing the statement:

```
180 P = (A * A) * 3.14
```

would cause the example program to become:

```
180 P = (A * A) * 3.14
183 REM INSERT THIS LINE
185 PRINT
```

Each line is terminated by a carriage return. Only after the carriage return is typed will BASIC store the new statement in the proper sequence in its memory. If after typing a line and before typing the carriage return, you should change your mind, simply enter a "control-X" (Control key depressed and X key struck) to delete the line. Single character typing errors can be corrected by typing a "control-0" for a backspace. The computer will print either a left-arrow (←) or an underline ( ) for each "control-0" pressed, and will backspace across the characters stored in the input buffer. The character displayed in response to a "control-0" will vary depending on the terminal used. If it is desired to stop a running program, or to terminate a LIST command, you should use the "control-C" character.

## VARIABLE NAMES AND DATA FORMATS

Now that you know how to enter a program, correct any mistyped lines, and how to stop a running program, we should probably find out how the "numbers" that control the program flow are referenced.

All numbers which can be changed during the execution of a program are called *variables*. Those numbers whose values cannot be changed other than by retyping a programming statement are called *constants*. Variables are referenced by a unique name given them by the programmer. A simple variable may be given a name of a single alphabetic or a single alphabetic character followed by a single digit 0 thru 9. Thus legal names for a simple variable are: A, B, Z0, Q5. Illegal names are 9, 5A, A34, AB. BASIC also has a type of variable known as an array. An array is defined as an ordered collection of numeric data known to BASIC under a single name.

An array may be given a name of a single alphabetic character, A to Z. BASIC allows the use of both the simple variable A and the array A in the same program.

Arrays are divided into columns (vertical) and rows (horizontal). Arrays may have one or two dimensions. For example:

```
1.01
2.11
3.22
4.34
```

is a one dimensional array while

```
6 5 4
3 2 1
0 9 8
```

is a two dimensional array.

Array elements are referenced by their column and row position. For instance, if the examples above were arrays A and Z respectively, 2.11 would be A(2); similarly, 0 would be Z(3,1). The references to array elements are called subscripts, and set apart with parentheses. For example P(1,5) references the fifth element of the first row of array P; 1 and 5 are the subscripts. In X(M,N), M and N are the subscripts.

The range of numbers that can be stored in a single element of an array, or in a simple variable is  $1.0 \times 10^{-99}$  to  $9.99999999 \times 10^{99}$ . There are nine digits of significance in this version of BASIC. There will be no radix or base conversion errors in this version of BASIC, because all numbers are stored internally in an exponential (floating point) base 10 format. All numbers are internally truncated to nine digits to fit this precision. Numbers may be entered and displayed in three formats: INTEGER, DECIMAL, and EXPONENTIAL. BASIC will automatically select the appropriate output format when executing a "PRINT" statement. Figure 2 identifies the three formats and gives examples.

### INTEGER (NO DECIMAL POINT)

1 998 10 999999999

### DECIMAL (FLOATING POINT NUMBERS)

.123456789 3.14 9.9965

### EXPONENTIAL (SCIENTIFIC NOTATION)

10E99 - 1.2345E76 1.2E - 99

E99 REPRESENTS  $10^{99}$  AND E - 99 IS  $10^{-99}$   
(E STANDS FOR EXPONENT)

Figure 2. Data Formats



NEW ... 1977

# MICROCOMPUTER CATALOG!



*Hundreds of microcomputer products and accessories from many manufacturers.*

Our new MICRO 77 Catalog provides you with a single, easy to use source for comparing and selecting microcomputers — from simple low cost trainers, to advanced systems designed for business, scientific, and engineering applications.

Whether you choose a kit or fully assembled unit, this easy to use catalog can help take the mystery out of selecting the computer system that is best for your application.

Included in this catalog is a convenient glossary of terms for reference, and sections covering:

MICROCOMPUTER SYSTEMS  
PERIPHERALS  
DEVELOPMENT AND TEST EQUIPMENT  
SOFTWARE  
BOOKS AND PROGRAMMED COURSES

Send \$1.00 (refundable with first order) for your copy today!

**microcom systems**

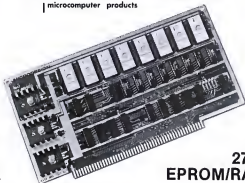
865 3rd Street South, St. Petersburg, FL 33701

CIRCLE INQUIRY NO. 3



**MICRODESIGN**

microcomputer products



8K

**2708  
EPROM/AM**

**VERSATILITY** • Individual Addressing • Shadow alternates ROM with RAM • External RAM disable • Optional 1K on-board RAM • S100 compatible • Power-on jump or bootstrap capability • All sockets included

MR 8 KIT ..... \$99.50 With RAM ..... \$124.95  
EPROM (shown) not included

## FIRMWARE

2K Monitor/Utility • Examine and change memory or registers • Read and write Tarbell Cassette, HEXASCII paper tape, binary paper tape • move or fill blocks • jump to user program restores registers • utility routines may be called by user programs

MM 2K ..... (two 2708 type EPROMS) ..... \$124.95

**MICRODESIGN**

8187 Havasu Circle, Buena Park CA 90621

(714) 523-8080

QUANTITY DISCOUNT AVAILABLE  
DEALER AND O.E.M. INQUIRIES INVITED

## COMMANDS

Although most BASIC statements will have line numbers, it is possible to communicate in BASIC by typing certain types of statements without line numbers. This type of statements is called *commands*. A command is a BASIC statement that causes immediate action. In contrast, however, a typical BASIC program is entered into the computer by typing it a line at a time; later typing a command (RUN) to cause the computer to begin executing the program in accordance with the programming statements previously stored in the computer's memory. When BASIC is ready for you to type a command or is able to accept a programming statement for storage, the word "READY" is displayed on the terminal. After each such entry the system will prompt for an additional command or programming statement by displaying a "#". When a command is typed, the computer will take immediate action on that command, and when the command has completed it will again respond with the word "READY" and a "#".

This version of BASIC will understand seven different commands: NEW LIST RUN SAVE LOAD APPEND PATCH. Each of these seven commands is described in full in the following section.

### COMMAND NAME DESCRIPTION OF COMMAND

#### NEW

The NEW command causes the current program to be erased. All working storage, internal pointers, and all variables will be reset. The effect of this command is to erase all traces of a program from memory and to start over.

#### LIST

The LIST command has several formats which can be used to cause all or selected portions of the current program to be displayed on your terminal. The lines are displayed in sequence with the lowest number first. The different LIST formats are as follows;

LIST will list the entire program from start to finish.  
LIST 100 will list only line 100.  
LIST 100,200 will list lines 100 thru and including line 200.  
LIST 100,1 will cause the program to begin listing at line 100 and will continue through to the end of the program. This operation will occur any time the second line number is less than the first.

#### RUN

The RUN command causes the current program in memory to begin execution at the first statement number. RUN always starts with the lowest line number and will proceed in sequential order unless directed to do otherwise with a GOTO, GOSUB, ON, or IF statement.

#### SAVE

The SAVE command causes the current program to be saved in a reloadable format on either the SWTPC AC-30 cassette interface

or on a TELETYPE papertape punch, or an equivalent device. The control characters necessary to control the recording and playback mechanisms are output along with the program. More complete details are given in LOAD.

#### LOAD

The LOAD command will first erase any program currently in working storage (as in the command NEW) and will then load a previously saved program. Control characters are output to control the reading mechanism. More complete details are given in APPEND.

#### APPEND

The APPEND command functions exactly like the LOAD command except that memory is not cleared prior to the load function.

#### PATCH

The PATCH command causes the computer to return to the MIKBUG operating system and outputs a carriage return, line feed, and an '\*' on the terminal device. If no memory belonging to BASIC (addresses \_\_\_\_\_ to \_\_\_\_\_) and the program counter (addresses A048 and A049) are not changed, typing a "G" will restart BASIC with your program intact. The PATCH command may even be inserted as a programming statement with a line number in your program. When the PATCH statement is encountered, control is transferred to MIKBUG. Upon typing a "G", control will return back to the line that immediately follows the PATCH command.

Note: All seven of the control commands described above may also be used as programming statements, if the control statement is typed following a line number. As a BASIC programming statement their action will be suspended until the program executes them in sequence.

Caution: Using the NEW statement as an executable statement will cause your program to self-destruct!

### PROGRAM STATEMENTS

Each program statement line begins with a line number which must be an integer between 1 and 9999. Statements may be entered in any order, but they will be executed in numerical order. Blanks, unless enclosed by quotation marks, are ignored. Program statements are limited to 72 characters including blanks. Nineteen types of program statements are allowed and are described in the following paragraphs. For your convenience the statements are listed in alphabetical order, rather than someone's "easy-to-learn" sequence. This will make it easier to use as a reference manual.

#### DATA

The DATA program statement causes data to be stored as part of a program. This data will be used by a READ statement. Data statements do not execute; they merely specify data. Multiple data items in a data statement must be separated by commas. Data statements may be placed anywhere in a program, and will be read in sequence as required. When the data is read in a pro-

## COMPU/TIME CT 100

COMPU/TIME offers

A Real Darn Clever  
Enhancement to users of  
IMSAI/ALTAIR Microprocessors

\$100 BUS COMPATIBLE

### TIME & CALENDAR

Microprocessors need the power that a real-time clock can offer. Date and time becomes instantly available. COMPU/TIME does not have to be initialized every time the system is powered up. It possesses a crystal-controlled time base to obtain superior accuracy and has two settable coincidence counters. Time, date, and counters are set via software.

### COMPUTATIONAL FUNCTION

Microprocessors need to be complimented by hardware arithmetics to free up memory pages dedicated to floating point routines and mathematical software. COMPU/TIME provides a 40 function calculator array so that algebraic, trigonometric, basic arithmetic problems can be solved without the need of developing sophisticated software.

### Buy It Your Way

COMPU/TIME	CT100	\$195 Kit	\$225 Assembled
COMPU only	CT01	\$149 Kit	\$169 Assembled
TIME only	T102	\$165 Kit	\$185 Assembled
COMPU/TIME PC Board only			\$ 80

ALL orders include Documentation, parts lists & software examples.  
BANK of AMERICA or CAL. Residents add 6% tax.  
MASTERCARD Welcome Delivery stock to 30 days.

### DEALER INQUIRIES INVITED.

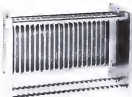
Designed by  
RDC Enterprises  
MICRO Processor Engineering  
and Consultants

Make checks payable to  
COMPU/TIME  
P.O. Box 417  
Huntington Beach, CA 92648  
Call: (714) 638-2094

CIRCLE INQUIRY NO. 4

## 19" RACKS-100 BUS CARD CAGE

CARD  
CAGE &  
MOTHER  
BOARD  
\$100



HEAVY DUTY  
POWER  
SUPPLY  
\$100

## 8,192 x 8 BIT STATIC MEMORY

Exceptionally Low Power



FAST  
BUFFERED  
KIT \$2.95

8080 CARD CAGE MICROCOMPUTER	KIT \$320
Z 80 CARD CAGE MICROCOMPUTER	KIT \$420
PROTOTYPING BOARD \$28	16K RAM
EXTENDER CARD \$24	2K RAM/2K ROM

### ELECTRONIC CONTROL TECHNOLOGY

P.O. BOX 6, UNION, NEW JERSEY 07083  
(201) 686-8080

CIRCLE INQUIRY NO. 11

# DO IT

with books from

## dilithium PRESS



### HOME COMPUTERS: 2<sup>10</sup> QUESTIONS AND ANSWERS Volume 1: Hardware

Rich Didday

So you bought a home computer. Now what?

This book is for the person with a micro-computer who wants to get an idea of what it can be like to use it to the fullest. Ideas for things to do, help in reading the literature, help in deciding what ways to go — it's all here in easy-to-understand language for the beginner.

175 pp  
dilithium Press

75 illus.

March 1977  
paper \$7.95

### HOME COMPUTERS: 2<sup>10</sup> QUESTIONS AND ANSWERS Volume 2: Software

Rich Didday

A companion volume to the above book, this guide leads the new micro owner through the thorny problems surrounding the selection and use of software.

150 pp  
dilithium Press

25 illus.

March 1977  
paper \$6.95

### HOME COMPUTERS: A BEGINNER'S GLOSSARY AND GUIDE

Merl Miller and Charles Sippl

What do you need to know to use a micro?

This book provides the fundamental knowledge and skills for the new micro owner. Written in a lively and straightforward style, it takes the mystery out of the basic mathematical and logical principles involved in working with computers.

150 pp  
dilithium Press

illus.

April 1977  
paper \$6.95

### PROGRAMMABLE CALCULATORS

Charles Sippl

Written at an easily understandable level, this pragmatic "how to use what's available" book offers a 16-page glossary of terms as well as an appendix of clearly defined capabilities of products presently on the market. In addition to being a tutorial book, it is also a guide to the calculator industry.

400 pp approx.  
Matrix Publishers

April 1977  
paper \$14.95

### INTRODUCTION TO PL/1

Uda Paach

This book is a simple yet complete introduction to the programming language which is rapidly becoming the most widely used high level language. The approach taken stresses the versatility of PL/1 and its ability to operate on a wide range of data formats.

350 pp approx.  
Matrix Publishers

illus.

May 1977  
cloth \$13.95

### YES

I want to do it with dilithium Press/Matrix Publishers books.

Send me the ones circled above.

\_\_\_\_ SHOW ME. Put me on your mailing list.

\_\_\_\_ Check enclosed. \_\_\_\_ MasterCharge

BankAmericard No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

(Add 50¢ postage & handling for each title)

Name \_\_\_\_\_

Address \_\_\_\_\_

dilithium Press      Box 92      Forest Grove, OR 97116

CIRCLE INQUIRY NO. 9

### DIM

gram, the data will be read in sequence from the first to last data statements, and from left to right within each data statement. Each data item may be read only once unless a RESTORE statement is executed. BASIC keeps track of data with a *pointer*. When the first READ statement is encountered, the pointer indicates that the first data item in the first data statement is to be used; the pointer is then moved to the second item of data, and so on. An example of the DATA program statement format is as follows: 100 DATA 123, 34.5, 695, 500

The DIM program statement allocates memory space for an array. In this version of BASIC, one or two dimensional arrays are allowed. Maximum array size is 255 x 255 elements. (This is not as much of a limitation as you might think — you would need 393,216 bytes of memory to contain an array of 65535 elements! and this doesn't allow for any memory to store the program code...) All array elements are set to zero by the DIM statement. Dynamic re-dimensioning of arrays is not allowed. Once an array has been defined, it must not be re-defined in the same program. If an array is not explicitly defined by a DIM statement, it is assumed to be defined either as an array of 10 elements or as an array of 10 x 10 upon the first reference to it in a program.

An array can be allocated only once in a given program, implicitly and explicitly. Only the variables A thru Z (not followed by a number) may be dimensioned. This does not prevent the use of a simple variable of the same name.

The working size of an array may be smaller than its physical size. For example, an array declared 5 x 5 in a DIM statement may be used to store fewer than 25 elements; the DIM statement supplies only an upper bound on the number of elements. In the example of A(5,5) the first position of this array is A(1,1) and the last is A(5,5). An example of the DIM program statement format is as follows;

10 DIM A(5,5), I(2,100)

### END

The END program statement causes the program to stop executing. BASIC will print the word "READY" and a "#" on the terminal device indicating that it is now able to accept commands. In this version of BASIC, END may appear more than once and need not appear at all. It is recommended, however, that the last statement of a program be an END statement. This clearly shows that a program has been completely loaded or saved. An example of the END program statement format is as follows;

9999 END

### FOR

The FOR program statement allows repetition of a group of statements within a program for a specified number of times. The variable name that follows the word 'FOR' is used to identify the related NEXT statement. In addition the variable is initially set to the value of the first expression (expression1). All statements between the FOR and the related NEXT statement are then executed. The named variable in the FOR statement is then incremented by the STEP

value (expression3) and compared to the upper limit (expression2). If the increment creates a value that is *greater than* the upper limit (expression2) control of the computer is passed to the statement immediately following the NEXT statement. If the increment operation results in a sum that is equal to or less than the upper limit, the programming statements that fall between the FOR and NEXT statements will be repeated. This looping process will be continued until the upper limit has been exceeded, or as the result of an IF statement, control is passed to a statement outside the scope of the programming loop. If no STEP value is specified, a value of +1 is assumed. The loop will be executed once, regardless of the value of the variable. Although expressions are permitted for the initial, final, and step values in the FOR statement, they will be evaluated only once, the first time the loop is entered. It is not possible to use the same indexed variable in two loops if they are nested. When the statement after the NEXT statement is executed, the variable is equal to the value that caused the loop to terminate, and not the TO value itself. The step size need not be an integer. For instance,

100 FOR N = 1 TO 2 STEP .01

is a valid statement which will produce exactly 100 loop executions, incrementing N by .01 each time. A negative step size may also be used, as seen below:

100 FOR Q1 = 100 TO 50 STEP - 2.5

Examples of proper FOR program statement formats are as follows;

320 FOR K = 1 TO 300

•  
•  
•

500 FOR variable = expression1 TO expression2 STEP expression3

•  
•  
•

760 FOR L9 = 200 TO 1 STEP - 1

See the description of NEXT statement for additional information.

## GOSUB

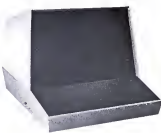
The GOSUB program statement causes the program to transfer control to the subroutine at the specified line address and returns to the line immediately following GOSUB XXXX. A subroutine is a sequence of instructions which performs a task that has use in more than one place in a program. To be able to use such a sequence of programming statements, BASIC provides the facility (GOSUB) to call upon such a sequence from more than one place in the program.

The subroutine is actually a sequence of instructions that will receive control upon the execution of a GOSUB statement. Upon completion of the subroutine, control is returned back to the mainline of the program by execution of a RETURN statement. The statement that immediately follows the original GOSUB statement will receive control when the RETURN is executed.

Subroutines may be nested to a level of 8 deep. That is, one subroutine may call a subroutine, which can call a subroutine, ... to a nested depth of 8 subroutines. An

# The Perfect Cover-Up!!!

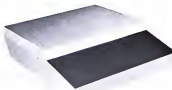
For The Computer Designer and Builder



VTE 101  
TERMINAL ENCLOSURE



KBE 101  
KEYBOARD ENCLOSURE



TVT 101  
TYPEWRITER ENCLOSURE

... AND THESE FEATURES ARE STANDARD:

- High Impact Structural Plastic Construction
- Flame Retardant
- Attractive Professional Appearance
- Easily Machinable Using Ordinary Woodworking Tools
- Highly Adaptable to Your Needs
- Ribs & Bosses for Component Mounting
- Molded Ventilation Grills
- Removable Keyboard Mounting Plate
- Available Unfinished or in Decorator Colors

*Inquire about special designs*

ENCLOSURE DYNAMICS, Inc.  
P.O. Box 6276  
Bridgewater, New Jersey 08807  
201-725-7982

## DISTRIBUTORS

### CALIFORNIA

Computer Shack  
22634 Foothill Blvd.  
Hayward, CA. 94542  
415-538-9080

Byte Shop Computer Store  
of Diablo Valley  
2988 North Main Street  
Walnut Creek, CA. 94596  
415-933-6252

### COLORADO

Gateway Electronics  
2839 West 44th Ave.  
Denver, CO. 80211  
303-458-5444

Byte Shop  
3464 So. Acoma St.  
Englewood, CO. 80110  
303-448-6233

### FLORIDA

Microcomputer Systems  
144 S. Dale Mabry Hwy.  
Tampa, Florida 33609  
813-879-4301

### ILLINOIS

American Microprocessors  
Equipment & Supply Corp.  
20 North Milwaukee Ave.  
Prairieview, IL. 60069  
312-634-0076

Lilliput Computer Mart  
4448 Oakton Street  
Skokie, IL. 60076  
312-674-1383

### MARYLAND

Computer Workshop, Inc.  
1308 Hounds Way  
Rockville, MD. 20852  
301-468-0455

### MASSACHUSETTS

Computer Mart, Inc.  
1097 Lexington St.  
Waltham, Mass. 02154  
617-899-4540

### MICHIGAN

Compumart, Inc.  
254 South Wagner Rd.  
Ann Arbor, Michigan 48103  
313-994-3200

### MINNESOTA

Microprogramming, Inc.  
12033 Riverwood Drive  
Burnsville, Minn. 55337  
218-894-3510

### MISSOURI

Gateway Electronics  
8123 Page Blvd.  
St. Louis, MO. 63130  
314-427-6116

### NEW JERSEY

William Electronics Supply  
1863 Woodbridge Ave.  
Edison, N.J. 08817  
201-985-3700

### NEW YORK

Computer Mart of N.Y.  
314 Fifth Ave.  
New York, N.Y. 10001  
212-279-1048

Computer Microsystems  
1309 North Blvd.  
Manhasset, N.Y. 11030  
516-627-3640

### PENNSYLVANIA

Philadelphia Heritage  
435 Spruce Street  
Philadelphia, PA. 19105  
800-523-2906

### TEXAS

The Micro Store  
634 South Central Expwy.  
Richardson, Texas 75080  
214-231-1096

### UTAH, NEVADA, IDAHO, WYOMING

The Computer Room  
1455 South 1100 East  
Salt Lake City, UT. 84105  
801-466-7911

### GERMANY

Datameg KG  
D 8011 Pilsbrunn  
Munich, W. Germany  
4-80-49-93

New Dealer Inquiries Invited

example of the GOSUB program statement format is as follows;  
235 GOSUB 9010

## GOTO

The GOTO program statement transfers control of the computer to the statement number specified. Program control will continue sequentially from the new statement. An example of the GOTO program statement format is as follows;  
100 GOTO 375

## IF

The IF program statement transfers control to a specified statement if the result of a conditional comparison is true.

The IF statement is used to control the sequence of program statements to be executed, depending on specific conditions. If the relational expression is true, then control is given to the statement or statement number declared after the THEN. If the relational expression is false, program execution continues at the statement that immediately follows the IF statement. The possible relational operators for use with the IF statement are as follows;

= Equal  
<> Not equal  
< Less than  
> Greater than  
<= Less than or equal  
>= Greater than or equal

If a BASIC statement is specified after the THEN condition, rather than a statement number, the statement specified will be executed if the conditional expression is true, and control will be passed to the

statement immediately following the IF statement.

It is possible to code another IF statement as the statement following the THEN condition —. This will give the equivalent of an "AND" condition.

When evaluating relational expressions, arithmetic operations take precedence in their usual order, and the relational operators are given equal weight and are evaluated last.

Examples of proper IF program statements formats are as follows;

190 IF X = 56 THEN 300

•

•

•

200 IF Z9 D + Y - (7\*S) THEN PRINT Z9;" is out of range"

•

•

•

2022 IF expression1 relational-test expression2 THEN basic-statement

•

•

•

2022 IF expression1 relational-test expression2 THEN statement-number

An example of A program to illustrate IF statements is as follows;

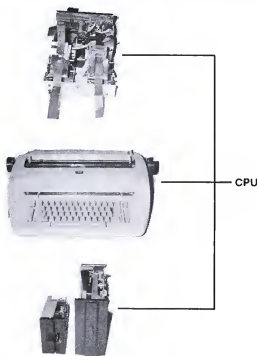
10 INPUT X

20 IF X = 1 THEN PRINT "EQUAL TO 1"

30 IF X <> 1 THEN PRINT "NOT EQUAL TO 1"

# FOR REAL RELIABILITY...at lowest cost

Get the first really effective Selectric® conversion kit. Not a mechanical nightmare or a collection of switches and coils, this unit is designed around specially built solenoids and the latest opto-electronics to achieve a superior product. This product gives you the usage of the same rugged mechanism that has been the industry standard.



Item	Description	Price
SK-1	Selectric conversion kit, with all mechanical and electronic parts. Needs 1 amp at 12 volts	118.00
SK-2	SK-1 with built-in power supply and TTL compatibility	168.00
SK-3	SK-2 with controller kit giving RS232 serial ASCII data at 110 or 300 BPS. A high speed paper tape interface is included	389.00
DK-1	Floppy disk and controller kit, with 350 KB drive. For use with SK-3, or any serial interface, up to 19200 BPS. Contains high level DOS, with simple commands making any terminal a smart one or any serial CPU a disk system	795.00

Manuals from above kits are offered for the purpose of evaluating the kits. Refunds for manuals apply on subsequent kit order.

SK-D1	Selectric Conversion Manual	6.50
SK-D2	Selectric Programming Manual, with listings and timing data	6.50
DK-D1	Floppy Disk Kit & DOS Manual	6.50

All orders acknowledged within 24 hours with firm shipping date. A 50% deposit is required on COD. Send check or MO to:



**Sharp & Associates**

Box 26045, Lakewood, Colorado 80226



## IS YOUR DOLLAR BUYING AS MUCH POWER & FLEXIBILITY AS TDL'S XITAN SYSTEMS PROVIDE?

OUR CUSTOMERS SAY  
THINGS LIKE THIS  
ABOUT TDL PRODUCTS:

"... the best CPU board I've put together... excellent parts...  
worked right off without trouble shooting."

JRG  
Cambridge, Mass.

"Great product."

KMM  
Bella Vista, Ark.

"... high quality components, good engineering & complete  
documentation... up and running without any problems."

WP  
Seattle, Wash.

"Excellent."

Col. DWV  
Santa Maria, Calif.

"Very impressed with superb quality."

SK-L  
Boston, Mass.

**XITAN**  
alpha 1

When we combined our highly praised ZPU board and our System Monitor Board, we defined the standard for the industry; we integrated more power and flexibility in two slots of our motherboard than most other systems can muster using five or more boards. When we put this setup into our rugged aluminum case we created the first XITAN system, the alpha 1. By adding a CRT terminal and/or teleprinter you will have a complete computer system.

KIT: \$769 ASSEMBLED & TESTED: \$1039

**XITAN**  
alpha 2

By adding a Z16 memory module and our PACKAGE A software to the alpha 1 we created a second XITAN system, the alpha 2. Thus, a complete and extremely powerful micro-computer system emerges well worthy of you who are operating at the most sophisticated levels. The XITAN alpha 2 provides you with 18K of RAM, 2K of ROM, 2 serial I/O ports, 1 parallel I/O port, our 1200 baud audio cassette interface as well as our extraordinarily powerful software package which includes 8K Basic, the Text Output Processor, the Zapple Text Editor and the Relocating Macro-Assembler. Add your own I/O device and GO...with the most powerful and flexible micro-computer package ever offered.

KIT: \$1369 ASSEMBLED & TESTED: \$1749

IF YOU ARE A BEGINNER, YOU WON'T EASILY OUTGROW THE XITAN SYSTEM.  
IF YOU ARE AN ADVANCED USER, YOU WILL DISCOVER XITAN IS EXACTLY WHAT YOU NEED.

\*Write for descriptive brochure on the XITAN alpha series  
and system software. When you ask at your dealer, say "ZY-TAN."

ORDERING INFORMATION: Send check, money order or BankAmericard, Master Charge  
current number and expiration date. Shipping is usually made via UPS or UPS Blue Label.  
Specify other arrangements if you wish. Prepaid orders are shipped postpaid.

**TECHNICAL  
DESIGN  
LABS**

RESEARCH PARK BLDG. H 1101 STATE ROAD  
PRINCETON, NEW JERSEY 08540 (609) 921-0321



```

40 IF X < 1 THEN PRINT "LESS
    THAN 1"
50 IF X > 1 THEN PRINT "GREATER
    THAN 1"
60 IF X <= 1 THEN PRINT "LESS
    THAN OR EQUAL TO 1"
70 IF X >= 1 THEN PRINT "GREATER
    THAN OR EQUAL TO 1"

80 PRINT
90 GOTO 10
100 END

```

#### INPUT

The INPUT program statement allows users to enter data from the terminal during program execution and to assign that value to a variable. The variable specified may be either a simple variable or a specified element in an array.

When the program comes to an INPUT statement, a question mark is displayed on the terminal. The user then types in the requested data separated by commas and followed by a carriage return. If no data is entered, or if the data entered is insufficient, the system prompts the user for more data with an additional question mark. Only numerical constants can be given in response to an input statement. Any number of variables may be specified on the INPUT statement, within the confines of the 72 character line, and the user must respond with a value for each specified variable. An example of the INPUT program statement format is as follows:

```
100 INPUT A,C,D
```

#### LET

The LET program or assignment statement is used to assign or specify the value of a variable. The value may be an expression, a number, or another variable. The keyword LET is optional, and need not be specified. There are four functions which may be used inside a formula on a LET statement. ABS (absolute value), INT (integer value), RND (random number), and SGN (sign *not sine*) may be used inside formulas or LET statements or anywhere else that a mathematical expression is allowed. Examples of proper LET program statement formats are as follows:

```

100 X = 123.45
110 LET Z9 = INT(RND(0)*100)
120 T5 = (A*A)*3.14
•
•
300 A(1,1) = X + P(M,N)
•
•
400 Z(I) = X

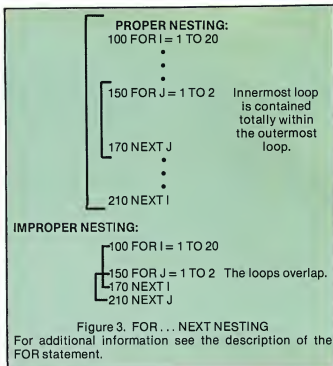
```

#### NEXT

The NEXT program statement is used to define the end of a "FOR . . . NEXT" loop. The variable specified in the NEXT statement identifies the associated FOR statement. Multiple FOR . . . NEXT statements may be used in the same program; They may also be nested (placed inside one another.) When nested, the innermost loop or loops must be wholly contained inside the outermost loop. The range must not overlap. An example of the NEXT program statement format is as follows;

```
220 NEXT K
```

Figure 3 illustrates proper and improper nesting.



#### ON

The ON program statement provides a computed GOTO or GOSUB mechanism. Instead of specifying the programming sequence of:

```

10 IF X = 1 THEN 100
20 IF X = 2 THEN 200
30 IF X = 3 THEN 300
40 IF X = 4 THEN 400

```

You could have used the following statement;

```
10 ON X GOTO 100,200,300,400
```

The computer would evaluate X, truncate the resulting value to an integer value, would then select the "Xth" statement number in the list of line numbers, and would use that value as part of a "GOTO" statement. Control of the computer would then be received by the selected line number.

In the example given above if the value of X was between 3 and 3.99999999 then the computer would GOTO 300. If the value of X was 1 then the computer would "GOTO 100". If the value of X is less than 1, or greater than the number of items in the list, the computer will generate an error message, and program execution will stop.

ON X GOSUB 100,200,300,400 works in a similar manner, except that the specified line numbers are assumed to be the start of a subroutine. When a RETURN statement has been executed, control on the computer will be returned to the statement immediately following the "ON X GOSUB" statement.

Note: The value X in the examples above can be any formula or mathematical expression. (additional note for FORTRAN programmers or individuals trying to convert FORTRAN to BASIC:

The FORTRAN IF statement can be simulated in BASIC thru the use of the ON . . . GOTO statement.

```
FORTRAN: IF (X-Y) 20,50,10
```

```
BASIC: ON SGN(X-Y) + 2 GOTO 20,50,10
```

# INTRODUCING THE COMPLETE CHALLENGER SYSTEM.



## OSI's DREAM MACHINE is a totally integrated computer system.

Imagine a system complete with terminal, CPU, memory, floppy disk, software, and all the little necessities to make it work together immediately. Now imagine this complete system available not only fully assembled, but priced much lower than anyone else's kit. What you are dreaming of is OSI's "new" Challenger System!

In the configuration shown above, the Challenger includes everything an end user needs for a complete small computer system. All you add is 110 VAC power and a desk to put it on.

This fully-assembled system includes:

### HARDWARE:

OSI Challenger 65 with 16K RAM, serial interface, system monitor PROM, and floppy disk bootstrap PROM.

OSI Challenger single drive floppy disk formatted for 250K bytes storage per diskette surface.

Stand-alone terminal and Sanyo monitor for 16 lines of 64 characters at 2400 baud (other terminal options are available). And all interconnecting cables!

### SOFTWARE:

2 diskettes containing over 100,000 bytes of software including OSI's powerful Disk Operating System with variable length sectors. **6502 DISK BASED RESIDENT ASSEMBLER/EDITOR!** A totally interactive Assembler/Editor which assembles up to 600 lines a minute and is completely compatible with MOS Technology's Cross Assembler format. This program also contains a powerful disk-based line editor with commands for general text editing. **OSI'S EXTENDED MONITOR:** A powerful machine language debugging and utilities package including a Disassembler which is format compatible with the Assembler! **OSI 6502 8K BASIC FOR DISK BY MICROSOFT:** This powerful BASIC has all the features of Altair's 8K BASIC for the 8080 plus higher speed and disk storage. And it comes complete with a BASIC program library.

### DOCUMENTATION AND SUPPORT:

We include over 600 pages of hardware, software, programming, and operation manuals. The Challenger is based on the well-proven OSI 400 system. The over 2,000 OSI 400s and Challengers now in use assure continuing hardware and software support for this system for years to come!

### EXPANDABILITY:

The Challenger System can now be expanded to 192K of RAM and 16K of I/O and ROM. There are over 13 accessory boards including A/D, D/A, parallel and serial I/O, cassette interfaces, a dual drive floppy, a video graphics display, several RAM and PROM boards, and multiple-processor configurations.

### APPLICATIONS:

The Challenger system is complete, fully assembled and configured so that the Disk Operating System can be booted in immediately on system power-up. Even a relatively inexperienced operator can have a complex BASIC program on-line just seconds after the system is turned on. The ease of use, high reliability, and large library of standard BASIC applications programs make the OSI Challenger System the first practical and affordable small computer system for small business, educational institutions, labs, and the personal computerist.

### PRICES:

Challenger System, complete as stated above with terminal and monitor

**\$2599.00**

As above without terminal. Specify RS-232 or 20ma loop and baud rate

**\$2099.00**

### IMPORTANT NOTE:

One of the most important features of the Challenger System is that it is not really "new". OSI has been delivering the basic circuitry of the Challenger since November 1975 and the floppy disk since June 1976. The only thing new is the total integration of the components as a complete, simple to use, fully-assembled, small computer system.

For more free information and the address of the OSI Computer Dealer or representative in your area, write to: OSI, Dept. S; Hiram, Ohio 44234 or enclose \$1.00 for the full OSI catalog which contains kits from \$134 and fully assembled computers from \$439.

# OSI

Ohio Scientific Instruments

11679 Hayden Street, Dept. S, Hiram, Ohio 44234

# Deal Yourself in...



Atlantic City, N.J.  
August 27th-28th

## What its all about!

Software Development  
Micro Computers  
Hardware Development  
Disc Memories  
Computer Comparisons  
Interfacing  
Program Implementation  
AMSAT  
Computerized Music  
Video Terminals  
Kit Construction  
Printers  
Computer Games  
Digital Tapes

- Seminars and Technical talks by leading electronic equipment manufacturers
- Major Exhibits from all over the country
- Demonstrations in many areas including Home and Personal Computing
- Door Prizes, Free Literature and Free Mementos
- All this plus Sun and Surf - Fun and Excitement - Relaxation and Leisure

 **Personal  
Computing  
77** Consumer Trade Fair

SPECIAL GROUP RATES FOR CLUBS AND  
ORGANIZATIONS TRAVELING FROM THE WEST  
COAST AND MID-AMERICA.

CONTACT  
Dawn Corrigan  
(213) 924-8383

Seven Seas Travel  
17220 S. Norwalk Blvd.  
Cerritos, CA. 90701

Write for FREE TRIP-KIT to PERSONAL COMPUTING 77,  
Rt 1, Box 242, Mays Landing, New Jersey 08330

EXHIBITION BOOTHS STILL AVAILABLE - CALL (609) 653-1188

## PRINT

(I will leave the determination of the correctness of the above example to the individual programmer needing the technique . . . )

The PRINT program statement causes the values of any variables specified in the PRINT statement to be output or printed on the terminal device. The PRINT statement can also be used to print out text, by enclosing the desired text to be printed in quotation marks (""). The statement

100 PRINT "HI THERE, I AM A SWTPC COMPUTER"

would cause the text "HI THERE, I AM A SWTPC COMPUTER" to be printed on the terminal device (the quotation marks would not be displayed or printed.)

The PRINT statement also makes use of the comma (,) and semicolon (;) to control the formatting of a print line.

In the statement PRINT A,B the numerical value of A will be printed beginning in the left hand margin, and the numerical value of B will be printed in column 18. Basic defines the 72 column line width into 4 zones starting in columns 18,36,48, and 60. The use of a comma in between data items will cause the printing mechanism to be advanced to the start of the next zone. This feature allows you to prepare tabular table data easily. The semicolon disables this "advance to next zone" mechanism and will cause the data items to be printed one after another. Numeric values will be separated by a blank for readability.

In addition if the PRINT statement is terminated by a semicolon, the computer will suppress the normal "carriage return, line feed", that is, automatically output at the end of each line. PRINT statement used with no operations or data items will cause a single blank line to be output.

This version of BASIC supports two special functions (TAB & CHR) that can be used only on the PRINT statement. The TAB function can be used to format items starting in columns other than 18,36,48, and 60. The CHR function is used to create special control characters that may not be generatable from your keyboard.

## READ

The READ program statement is similar in function to the INPUT statement except that the next DATA item is read, rather than getting a numeric value from the terminal. READ statements cause values in the DATA buffer to be accessed in a left to right, top to bottom sequential manner and assigned to the variable named in the read statement. If more than one variable is named in the READ, the values read from the DATA statements will be assigned, in the order read to the variables named on the READ statement. For additional information, see the description of the DATA and RESTORE statements. Examples of proper READ program statement formats are as follows;

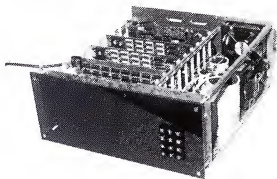
100 READ A

200 READ A,Q9,B

## REM

The REM program or remark statement allows insertion of a line of remarks or comments in the listing of a program. REM lines are saved as a part of a BASIC program, and are printed when the program is listed,

## BUILD THE CRATE!



### THE S-100 CARDFRAME THAT

**YOU CAN BUILD FOR LESS THAN \$150**

COMPLETE PLANS, INFO ON TOOLS, PARTS, SOURCES, ETC.

ORDER THE CRATE BOOK .....\$19.95

### ENCOUNTER!

FOR GAME LOVERS, REALTIME GAMEBOARD WARFARE ON A VDM. NO TAKING TURNS, JUST ACTION, STRATEGY, AND LOGISTICS.

8080 CODE ON P-TAPE + SOURCE, RULES .....\$16.95

### USE SYS 8/SOFT PKG 1?

AUTO-LINE ENTRY, STRING EDIT, AUTO TABS, OCTAL NBRS. MULT. SECTION ASSEMBLIES, MORE ADDED BY OUR PROGRAM.

SOURCE ONLY. SPKG. 5 .....\$14.95

## OBJECTIVE DESIGN, INC.

P.O. BOX 20325, TALLAHASSEE, FL. 32304

CIRCLE INQUIRY NO. 39

## 1702A MANUAL EPROM PROGRAMMER

Features hex keypad, two digit hex address and two digit hex data display. Controls include load, clear, go! (step), key/copy, data in/data out, and counter up/down. Profile card includes high voltage pulse regulator, timing, 8 bit address and 8 bit data drivers/receivers. Two 6 1/2" x 9" stacked cards with spacers. Allows programming in 20 minutes - copying in 5 minutes. Requires +5, -9, and +80 volts.



ASSEMBLED .....\$299.95  
KIT .....\$189.95

### NOW

The best of two worlds... use our 1702 EPROM programmer as a manual data/address entry programmer... or connect it to your processor.

IMSAI/ALTAIR computer interface (requires 3 output ports, +1 input port) and software .....\$49.95

Briefcase unit with power supplies and interface connectors (assembled and tested only) .....\$599.95

### ANNOUNCING

Our NEW 16K Byte Pseudo-Static, IMSAI/ALTAIR compatible RAM. Single card slot. Uses less power than equivalent low power RAM. All memory chips socketed. Uses all prime, factory fresh ICs. High quality, two-sided, through-hole plated circuit board. Crystal controlled, totally invisible refresh system requires NO software management. Just plug it in and use like STATIC memory.

Complete kit .....\$349.95  
Assembled, tested, and burned in .....\$549.95

### ASSOCIATED ELECTRONICS

12444 Lambert Circle • Garden Grove, CA 92641  
(714) 539-0735

CIRCLE INQUIRY NO. 1

but they are ignored when the program is executing. An example of the REM program statement is as follows;

```
300 REM
```

**RESTORE** In the discussion on the DATA and READ statements, it was stated that once a data item was read, it could not be re-read. This is only partially true. The RESTORE program statement is used to reset the internal data pointer that BASIC uses, back to the first data item on the first data statement. Thus the entire data list may be re-read from the beginning.

The only way that you can re-read a particular data item, is to keep track of how far down the data list it is; RESTORE the data pointer, and then READ "n-1" numbers throwing all of the previous numbers away. The data pointer has now been "reset" to a particular data item, so that it can be re-read . . . clearly not a very practical technique for most programs!! An example of the RESTORE program statement format is as follows;

```
500 RESTORE
```

**RETURN** The RETURN program statement is used to define the logical end of a subroutine, and when executed will cause control of the computer to be transferred to the statement immediately following the *last* GOSUB executed. A subroutine may call a subroutine, which calls still another subroutine. This may be done to a nested level of 8 deep. You must take care not to execute a return statement unless you have executed a GOSUB first. An example of the RETURN program statement format is as follows;

```
1000 RETURN
```

**STOP** The STOP program statement operates in a similar fashion to the END statement; both cause the currently running BASIC program to stop running. The STOP statement, however, will identify the line number of the statement that caused the stop; while the END statement merely stops the program without identifying where the "end" occurred. This feature of the STOP statement makes it useful in identifying "error" conditions. For instance, in the following example the computer will print "STOP at 100" if the number typed in response to the INPUT statement is less than zero.

```
90 INPUT X
100 IF X < 0 THEN STOP
```

An example of the STOP program statement format is as follows;

```
990 STOP
```

## FUNCTIONS

The following functions are available in Robert Uiterwyk's 4K 6800 BASIC.

**ABS(x)** The ABS or absolute function will take the absolute value of the expression x. If the value of the expression is a negative number then the value return by the absolute function will be a positive value. A positive value will remain a positive value.

if Z9 is a -32 then the ABS(Z9) will be a +32  
if Q5 = +6 then the formula ABS(Q5 + 3) will return a value of +9.

**INT(x)** The INT or integer function is used to truncate or "chop-off" any decimals in a floating point number. Positive values will be chopped off to the next lower integer, and negative numbers will be rounded up to the next lower value. INT(9.765) will result in a value of 9.

INT(-10.2) will result in a value of -11.

**RND(x)** The RND or random number generator generates a pseudo-random number ranging between 0.0 and 1.0. If the argument (x) is not equal to zero, it will be used as a new seed for the random number generator. The value returned as the result of specifying a new seed should be ignored. A new random number will be received when the argument specified is zero. In this version of BASIC it is not necessary to seed the generator in order to start a new random series of numbers at the start of a game.

**SGN(x)** The SGN or sign function returns a -1, 0, or +1 value depending on the magnitude of the expression (x). If x is less than zero, the SGN will return a value of -1. If x is equal to zero, SGN will return a value of zero. If x is greater than zero, SGN will return a +1.

if Z9 is a -45.987 then SGN(Z9) will be a -1  
if Q is a +34.59 then SGN(Q) will be a +1  
if R is a -10 and S is a -5 then SGN(R-2\*S) will be 0.

**CHR(x)** The CHR function is used to convert the value of X (which must be between 1 and 255) to a single ASCII character. Thus CHR(16) will create a "CONTROL-P" and CHR(22) will create a "CONTROL-U". The CHR function may be used only on the PRINT statement and is useful for creating special control characters required for terminal control.

**TAB(x)** The TAB function can be used only in a PRINT statement. The value of X will cause the print mechanism to be positioned at column X. TAB(10) will cause a tab to column 10, TAB(50) will cause a tab to column 50. The value of the TAB function must be from 1 to 72.

**USER** The USER function is used to call a user defined assembly language subroutine.

## OPERATORS

Symbols used to instruct the microcomputer to perform some operation are called operators. This version of BASIC includes arithmetic and relational operators.

**ARITHMETIC OPERATORS** — Five standard BASIC arithmetic operators are provided with this version of BASIC. The arithmetic operators are as follows:

- Unary negation
- \* Multiplication
- / Division
- + Addition
- Subtraction

**RELATIONAL OPERATORS** — Standard BASIC relational operators are provided for comparing the values of integer expressions. The relational operators are as follows;

- = Equal
- > Not equal
- < Less than
- > Greater than
- <= Less than or equal
- >= Greater than or equal

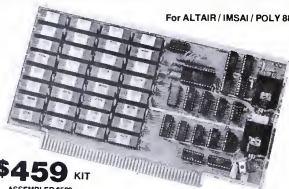
## ERROR MESSAGES

The following error messages can be created by BASIC at any time:

ERROR CODE	MESSAGE DESCRIPTION
1	OVERSIZED VARIABLE. A TAB, CHR, ON or subscript value was greater than 255.
2	INPUT ERROR.
3	ILLEGAL CHARACTER OR VARIABLE. An illegal variable name of an invalid character was found during the evaluation of a mathematical expression.
4	NO ENDING "IN PRINT LITERAL. A missing quotation mark was detected in a print statement. There must be an even number of quotation marks on a print statement. The character (") cannot be output as a text character except by specifying CHR(34).
5	DIMENSIONING ERROR. Only two dimensions are allowed, and must be a value between 1 and 255. Once defined an array may not be defined again. Place all DIM statements at the start of the program, where they can not be accidentally executed a second time. All references to an array which is defined on a DIM statement must occur after the DIM statement has been executed.
6	ILLEGAL ARITHMETIC. The most common cause of "illegal arithmetic" is two arithmetic operators following each other, without a numeric value separating them. "2+ -3" is illegal arithmetic.
7	LINE NUMBER NOT FOUND. The "GOTO", "GOSUB" or "IF . . . THEN" line number does not exist in the program. If necessary a REM statement may be used as a dummy line to resolve a missing line number.
8	DIVIDE BY ZERO ATTEMPTED. You just can't do it! If there is no way to prevent it, place an "IF" statement prior to the divide and branch around the divide statement if a divide by zero might occur.
9	EXCESSIVE SUBROUTINE NESTING. The maximum number of subroutines that may be nested is 8. Generally when this occurs it is because a GOSUB is accidentally being executed, or somehow a return statement has not been executed.
10	RETURN without PRIOR GOSUB. You executed a RETURN statement without first executing a GOSUB. This is a no-no.
11	ILLEGAL VARIABLE. The name for the variable is not correct. An array may only be named with a single alphabetic character. A(1) is correct, A5(1) is not. A simple variable may be named either with a single alphabetic character, OR a single alphabetic character followed by a single numeric character. A, B0, C1 are legal names. 1A, BB, C3A are not legal names. This version of BASIC does not support character string variables (A\$, B\$ etc.)
12	UNRECOGNIZABLE STATEMENT. This first word in the statement was not a recognizable COMMAND or BASIC statement name; nor was it a variable (simple or array) name followed by an equal sign (=). This latter case is known as an implied LET statement.
13	PARENTHESIS ERROR. Either you have too many opening parenthesis "(" or too few closing ones ")". There must be exactly the

## 16K STATIC RAM

For ALTair / IMSAI / POLY 88



**\$459 KIT**  
ASSEMBLED \$529

- USES 4K STATIC RAMS - NO REFRESH
- VERY LOW POWER - LESS THAN 1 AMP
- Z80 FAST - 200ns ACCESS TIME
- PROVISION FOR BATTERY BACKUP
- LOW PROFILE SOCKETS FOR ALL CHIPS
- EACH 4K ADDRESSABLE TO ANY 4K SLOT
- HARDWARE/SOFTWARE MEMORY PROTECT FOR EACH 4K
- SPECIAL PAGING OPTION ALLOWS UP TO 1 MEGABYTE ADDRESSABLE MEMORY
- LOW COST

CONSTRUCTION MANUAL ..... \$1.75  
PAGING OPTION ..... \$9.00  
QUANTITY DISCOUNT ..... 5 BOARDS - 5%  
10 OR MORE - 10%

DEALER INQUIRIES INVITED

**OMNI SYSTEMS INC.**  
P.O. BOX 7536, UNIV. STATION  
PROVO, UTAH 84602

CIRCLE INQUIRY NO. 42



## PRAMMER

by XYBEK

**An extraordinary 2k memory board  
for your Altair-bussed computer**

- ★ On-board 1702A PROM programmer
- ★ Space for 1792 bytes of read-only memory (seven 1702A EPROMs)
- ★ 256 bytes of RAM
- ★ Supplied with one 1702A, pre-programmed with stand-alone programming software — no sense switches are used
- ★ Supplied with programming power supply
- ★ PRAMMER's own on-board clock makes it compatible with almost any Altair-bussed system.
- ★ All read and write sequences are generated via an on-board micro-programmed state machine, thus eliminating all one-shots.
- ★ Complete 1702A programming in 18 seconds

**COMPLETE KIT: ..... \$209**

(\$189 through June 14, 1977)

**Assembled and tested: ..... \$289**

Immediate (off-the-shelf) delivery

California residents please add sales tax.  
Master Charge and BankAmericard accepted.

**XYBEK • P.O. Box 4925 • Stanford, CA 94305**  
Telephone: (408) 296-8188

CIRCLE INQUIRY NO. 61



same number of opening and closing parenthesis in a programming statement.

- 14 **MEMORY FULL.** You just ran out of memory. Try to reduce the number of variables used in the program. If arrays are being used make sure that they are dimensioned to the exact size required. Reduce the amount of remarks and the amount of PRINT statements used. Look and see if any routines are similar enough in nature to be made a subroutine. Look for more efficient algorithms to solve your problem. Split the program up into several different programs. If all else fails, go buy some more memory!
- 15 **SUBSCRIPT ERROR.** The array was defined as a one dimensional array and the reference contains two dimensions, or vice-versa.
- 16 **EXCESSIVE FOR LOOPS ACTIVE.** The maximum number of nested FOR ... NEXT loops is 8.
- 17 **NEXT WITHOUT CORRESPONDING FOR.** A NEXT statement has been found without a corresponding FOR statement. The named variable that occurs after the word "FOR" and after the word "NEXT" is used to identify corresponding "FOR" and "NEXT" statements.
- 18 **MISNESTED FOR NEXT LOOPS.** The computer has detected an improper nesting for multiple "FOR ... NEXT" statements. See Figure 3 for an explanation of the proper and improper way to nest "FOR ... NEXT" statements.
- 19 **READ STATEMENT ERROR.** Read statement was executed, and there is not enough data in the data buffer to satisfy the READ request.
- 20 **ERROR IN ON STATEMENT.** The expression when truncated to an integer value resulted in either a value less than one, or in a value that is greater than the number of statement numbers in the list. In the example below an error 20 will occur if the value of (X-Y) is less than 1 or greater than 5.  
100 ON (X-Y) GOTO 1000,235,3000,20,35
- 21 **INPUT OVERFLOW.** More than 72 characters were typed on the line.

GOTO	TRANSFERS CONTROL TO OTHER THAN THE NEXT SEQUENTIAL STATEMENT	
IF	CONDITIONAL TEST USUALLY USED TO TRANSFER CONTROL "IF"	THEN
INPUT	GET DATA FROM KEYBOARD OF ATTACHED TERMINAL	
LET	ASSIGNMENT OR CALCULATION STATEMENT	
NEXT	DEFINES END OF PROGRAMMING LOOP	FOR
ON	COMPUTED "GOTO" OR "GOSUB"	GOSUB GOTO
PRINT	PUT DATA TO PRINTER OR CRT OF ATTACHED TERMINAL	
READ	GET DATA FROM "DATA" STATEMENTS	DATA RESTORE
REM	PROGRAMMERS COMMENT	
RESTORE	RESETS THE DATA POINTER IN "DATA" STATEMENT	DATA READ
RETURN	DEFINES END OF SUBROUTINE — CAUSES CONTROL TO BE TRANSFERRED BACK TO STATEMENT IMMEDIATELY FOLLOWING THE GOSUB STATEMENT	GOSUB
STOP	DEFINES THE END OF THE PROGRAM; AND IDENTIFIES THE STATEMENT NUMBER OF THE STOP.	END

Figure 4. Quick definition of BASIC Statements

#### GRAMMAR REFERENCE SUMMARY

Figure 4, Quick definition of BASIC Statements, and figure 5, BASIC functions, provide a quick reference for using, Robert Uiterwyk's 4K 6800 BASIC Interpreter.

STATEMENT	DEFINITION	RELATED STATEMENT(S)
DATA	'STORES' DATA TO BE USED BY READ STATEMENT	READ RESTORE
DIM	DEFINES SIZE OF ARRAYS (1 or 2 dimensions are allowed.)	
END	DEFINES END OF PROGRAM	STOP
FOR	DEFINES START OF PROGRAMMING LOOP	NEXT
GOSUB	TRANSFERS CONTROL TO A SUBROUTINE	RETURN

ABS( )	ABSOLUTE VALUE
CHR( )	CONVERSION OF VALUE TO A SINGLE CHARACTER
INT( )	INTEGER VALUE (TRUNCATES DECIMAL VALUE)
RND( )	RANDOM NUMBER GENERATOR; RETURNS VALUE FROM .000001 TO .999999
SGN( )	SIGN OF X; RETURNS A + 1, 0, or - 1
TAB( )	USED IN PRINT STATEMENT ONLY; CAUSES A TAB TO THE SPECIFIED COLUMN
USER( )	CAUSES A CALL TO A USER DEFINED ASSEMBLY LANGUAGE SUBROUTINE.

Figure 5. BASIC Functions

**HOBBY-WRAP** WIRE-WRAPPING, STRIPPING, UNWRAPPING TOOL FOR AWG 30 (.025 SQUARE POST)

**MODIFIED WRAP**  
**WSU-30M**



**STRIP**



**WRAP**



**UNWRAP**

**\$6<sup>95</sup>**

SHIPPING CHARGE \$1.00  
RESIDENT AND SALES TAX



**REGULAR  
WRAP**

**PART No.  
WSU-30**

**TYPES OF WRAP**

■ A "Regular" bit wraps the bare wire around the terminal. A "Modified" bit wraps a portion of insulation around the terminal in addition to the bare wire. This greatly increases the ability to withstand vibration.



**MODIFIED  
WRAP**

**PART No.  
WSU-30M**

**HOBBY-WRAP** WIRE-WRAPPING, STRIPPING, UNWRAPPING TOOL FOR AWG 30 (.025 SQUARE POST)

**REGULAR WRAP**  
**WSU-30**



**STRIP**



**WRAP**



**UNWRAP**

**\$5<sup>95</sup>**

SHIPPING CHARGE \$1.00  
RESIDENT AND SALES TAX

**OK MACHINE & TOOL CORPORATION**

3438 CORNER STREET, BRIDGE, NEW YORK, N.Y. 10515 U.S.A. • PHONE (516) 964-8800

TELEX: 129601 TELEX: 232395

# HELP YOUR COMPUTER UNDERSTAND YOUR VOICE

by Owen F. Thomas

Talking computers these days make talking animals seem ordinary. But listening computers present a whole new array of problems that our new group of computer hobbyists — the "Thinker Tinkers" — might well solve. Or, at least, enjoy the tinkering.

The "Hear What I Mean" — HWIM — machine was built by Bolt, Beranek, and Newman Inc. and has served in pioneering studies of recognition vocabularies for computers. It can presently 'understand' 1097 words and three different male American speakers with an overall accuracy of 43 percent. It uses a 1967 vintage computer to process one second of speech in 1350 seconds.

Although a voice-recognition system using a Motorola 6800 microprocessor and accompanying equipment can do a spectrum analysis of one second of speech in 375 seconds, much experimentation and research into the tasks of recognition remain for "Thinker Tinkers" with which to tinker.

So far, HWIM has rather limited results in voice recognition. Each speaker may have to learn to control his voice very carefully and to provide his own voice-identification records before he can talk to the computer.

A speaker training himself to repeat his messages

will find that a spectrum analyzer with a good display is a useful tool. Spectrum analysis measures fluctuating phenomena and describes the amount of fluctuation. Figure 1 shows a general diagram of a spectrum analyzer. Such an analyzer can measure effects of attempted voice control and allow refinement until the fluctuations are satisfactory. This is computer feedback applied to control of speech or singing.

For example, a singer uses the fluctuations of air pressure in his throat to produce pleasant sounds. How does he control the fluctuations of air pressure?

Some people are natural-born singers, but most require the services of a voice teacher. The voice teacher listens and recommends breath controls and exercises to the student. The voice teacher is performing a spectrum analysis with his ear and brain. He knows what voice spectrum is pleasant and has some idea of how to produce it.

A microphone attached to a preamplifier provides an electrical sample of the pressure fluctuations for spectrum analysis. The transducer in Figure 1 becomes a microphone for the voice student. The student sings into the microphone and the computer performs a spectrum analysis for display. Student and teacher learn

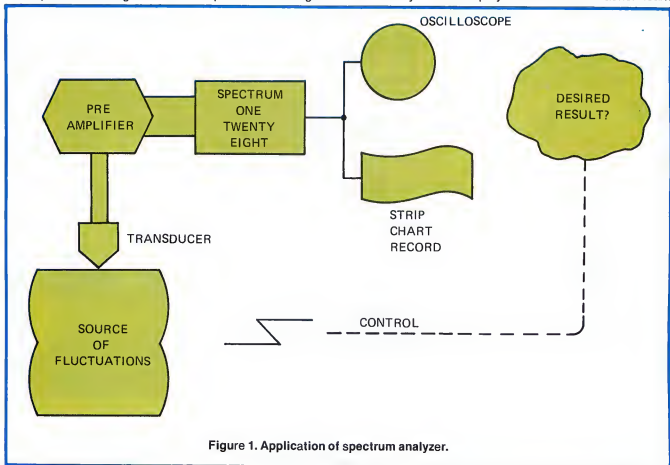


Figure 1. Application of spectrum analyzer.

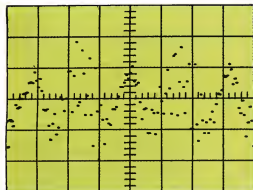


Figure 2. Vowel "A" fluctuations as in "pay".

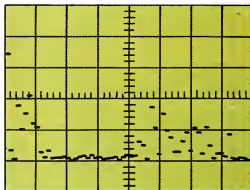


Figure 5. Vowel "E" spectrum as in "pea".

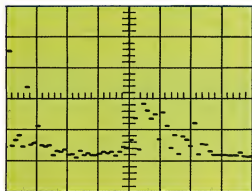


Figure 3. Vowel "A" spectrum as in "pay".

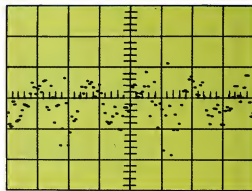


Figure 6. Vowel "I" fluctuations as in "pie".

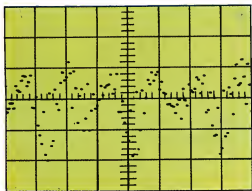


Figure 4. Vowel "E" fluctuations as in "pea".

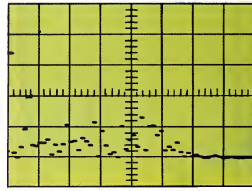


Figure 7. Vowel "I" spectrum as in "pie".

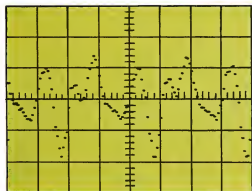


Figure 8. Vowel "O" fluctuations as in "poe".

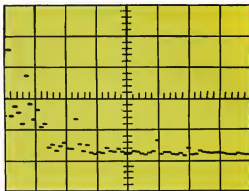


Figure 11. Vowel "U" spectrum as in "you".

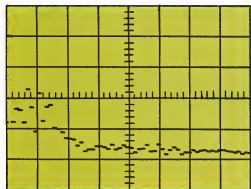


Figure 9. Vowel "O" spectrum as in "poe".

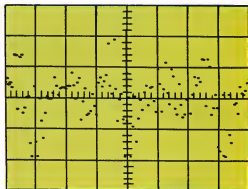


Figure 12. Repeat of vowel "A" fluctuations as in "pay".



Figure 10. Vowel "U" fluctuations as in "you".

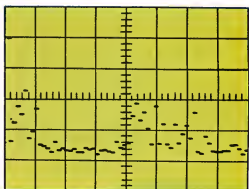


Figure 13. Repeat of vowel "A" spectrum as in "pay".

some interesting lessons when they can both see and hear the result of their attempts to control sounds and to reproduce them exactly. This is feedback applied to control sounds and their exact reproduction, and feedback applied to control of the body (or biofeedback) in a learning situation.

## SPECTRUM ANALYZER DESCRIPTION

A spectrum analyzer measures the amount of sound fluctuations and describes their character. Many commercial models have a great variety of sophisticated uses. The technique I used, as described here, is a purely digital one known as the Fast Fourier Transform. The programming theory is complicated, but the operation is easily understood when in a PROM. I used a new system called SPECTRUM-128, which employs a Motorola 6800 microcomputer on a board with a PROM.

Fluctuation means "a moving back and forth or up and down; rising and falling, as of waves." One can interpret this in two valid ways when describing a phenomenon for spectrum analysis. The most common describes the motion as of a body in the ocean at a fixed latitude and longitude as time progresses. The second describes variations with distance at a fixed time, as seen in, say a photograph of the ocean against a breakwater. The spectrum analyzer used here sampled an electrical signal at evenly spaced intervals of time. The electrical signal is generated in an electrical device or derived from some fluctuating source by means of a transducer and preamplifier. A familiar form of fluctuation is the sine wave produced by a resonant device, such as a crystal in an oscillator circuit.

Fluctuations are measured in the spectrum analyzer by comparison with sine wave reference standards. The standards comprise a set of sine waves ranging from

## Confused About Printers?



### MPI HAS YOUR ANSWER!

TTY REPLACEMENT? ..... THE SSP-40 **\$575**  
The SSP-40 carries its own microprocessor for easy connection to your serial port.

LOW COST BUSINESS SYSTEM? ..... THE MP-40 **\$425**  
The MP-40 connects to your parallel port for ASCII data transfer.

MINIMUM COST FOR HOBBYIST? ... THE KP-40 KIT **\$179**  
The KP-40 KIT contains mechanism and minimum electronics for connection to your parallel port.

All of our 40 series printers use the same reliable 5x7 impact dot matrix mechanism with up to 40 columns per line on ordinary paper with a print speed of 75 lines/minute.

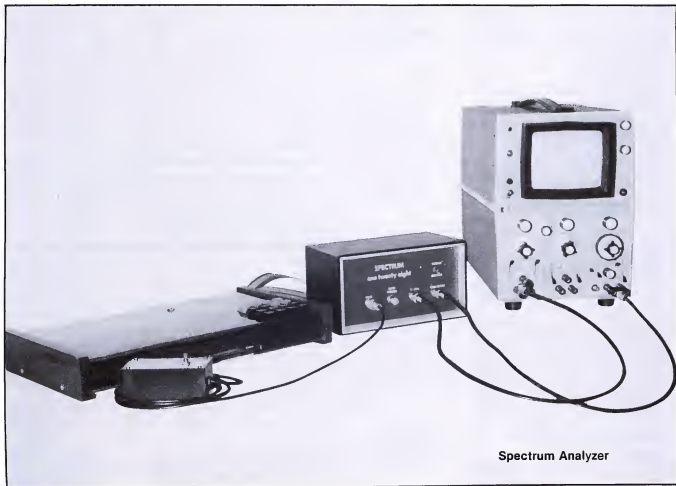
MASTER CHARGE WELCOME • UTAH RESIDENTS ADD 5% SALES TAX

**mpi**

SEND FOR FREE LITERATURE

MICROPROCESSOR SYSTEMS AND PERIPHERALS  
P.O. BOX 22101/SALT LAKE CITY/UT. 84122  
(801) 566-0201

CIRCLE INQUIRY NO. 37



Spectrum Analyzer



zero frequency, or d.c., to an upper frequency limit imposed by the number of the digital samples taken from the fluctuating source. The upper frequency limit is that frequency which would go through a complete cycle while two samples are taken. The standard sine waves are in digital numbers representing the result that would be obtained by sampling an integer number of sine wave cycles. SPECTRUM-128 samples the fluctuations 128 times. So the maximum number of integer cycles that could be sampled is 64. A fluctuation occurring 64 times during the sampling process corresponds to the highest rate of fluctuations that can be correctly measured. For all digital systems, the highest frequency that can be correctly measured, known as the aliasing frequency, is half of the sampling frequency. The sampled fluctuation is compared to the standards to determine its correlation.

If the sampled fluctuation is a sine wave with a frequency of "X" cycles during the sampling process, it will correlate exactly with the stored sample of "X" cycles when "X" is an integer. The spectrum analyzer then reports that there is power in the "X" cycle result exclusively. When "X" is not an integer, the major correlation will be with the stored reference closest to "X" cycles, but there will also be some correlation to many nearby frequencies of the reference set. The spectrum analyzer will then report that there is power at nearby frequencies. When the fluctuation is not a sine wave, the spectrum analyzer determines what collection of sine waves can be used to best describe the fluctuation. For a precise mathematical description of all these relationships, one must study the theory of Fourier analysis.

The spectrum analysis results in a measurement of how much power is in every frequency relative to the maximum amount allowable in a single sine wave fluctuation sampled by the digital sampling input to SPEC-

TRUM-128. The measure of relative power is in decibels, the standard used by engineers. This measure is closely related to psychological responses. Three decibels correspond to the change of sound power which is perceived as a noticeable step of power. An increase of three decibels increases the sound pressure to 1.41 times the former pressure; a decrease of three decibels decreases the sound pressure to 0.71 times the former pressure. The increase of pressure corresponds to double the power; the decrease of pressure corresponds to half the power.

**For all digital systems, the highest frequency which can be correctly measured, known as the aliasing frequency, is half of the sampling frequency.**

SPECTRUM-128 presents the sampled data or the spectral results in analog form for easy and fast display. Pictures of results displayed on an oscilloscope illustrate the concepts. The display presents 128 values on the oscilloscope, then repeats the full display. When the 128 values represent the samples from the fluctuating source, they are referred to as a *frame of data*. When the 128 values represent results of spectrum analysis, only 64 separate frequency measurements occur, and the oscilloscope speed shows only 64 values, the spectrum corresponding to the frame of data.

**There are half as many frequency measurements as there are samples of the fluctuations.**

In describing spectrum analysis, we discussed how many cycles of fluctuations were compared to the reference, but we made no mention of the frequency. The rate of conversion from fluctuating electrical to digital input numbers determines the frequency scale. If each conversion occurs in 1/128th of a second, the entire data frame is sampled in one second. Then we could speak of the cycles as cycles per second (CPS). We would have one integral value of the reference sine wave for each CPS from 0 through 64. This relation of number of samples to frequency measurements is typical of digital systems: There are half as many frequency measurements as there are samples of the fluctuations.

**The frequency increment between measurements, often called the bin width, is the aliasing frequency divided by the number of frequency measurements.**

For the examples used in the illustrations, conversions were made at 8000 per second to select an aliasing frequency (the maximum frequency that can be measured correctly) of 4000 Hz. The frequency increment between measurements, often called the bin width, is the aliasing frequency divided by the number of frequency measurements. (The three important relationships of spectrum analysis have now been stated; see Table I for a convenient summary.) There are only 64 measurements in the examples, so there is only one measurement for each 4000/64 or 62.5 Hz.

To state this result another way, the entire data frame was sampled in 128/8000th of a second. The spectrum output results are in terms of cycles per 128/8000 or 0.016 second. A sine wave of 62.5 Hz will require 1/62.5 or 0.016 second to go through one cycle while the analyzer samples one frame of data. Thus, the spectrum

## comptek Boards DO Something



CL2400

Real Time Clock

\$98—Kit

\$135—Assembled

If your system needs to know what time it is, our CL2400 is the board for you. The present time in hours, minutes, and seconds is always available for input, and is continuously updated by the highly accurate 60 Hz power line frequency. Need periodic interrupts? The CL2400 can do that, too, at any of 6 rates. Reference manual with BASIC and assembly language software examples included.



PC3200

Power Control System

PC3232 \$299—Kit \$360—Asm.

PC3216 \$189—Kit \$240—Asm.

PC3202 \$39.50—Kit \$52—Asm.

If your system needs on/off control of lights, motors, appliances, etc., our PC3200 System components are for you. Control boards allow one I/O port to control 32 (PC3232) or 16 (PC3216) external Power Control Units, such as the PC3202 which controls 120 VAC loads to 400 Watts. Optically isolated, low voltage, current-limited control lines are standard in this growing product line.

**comptek**  
"Real World Electronics"

P.O. Box 516  
La Canada, CA 91011  
(213) 790-7957

CIRCLE INQUIRY NO. 2

# A STORY IN THREE ACTS

**ACT 1** Our story begins with the ACT-I terminal—the world's first Affordable Computer Terminal. The ACT-I is an exceptionally practical interface between man and machine for any computer system which communicates over a serial ASCII link. Whether querying a microprocessor based system or time-sharing on a major computer net, the ACT-I is the most economical method of alphanumeric communication at data rates from 110 baud all the way to 9600 baud. The ACT-I video computer terminal manages a 1024 character display memory organized as 16 lines of 64 characters chosen from the standard upper case ASCII set. Receipt of more than 64 characters on a line or the 'CR' code initiates a scroll operation. The entire screen may be locally cleared at any time by depressing the 'CLEAR' key.

## I/O SPECIFICATIONS (JUMPER SELECTABLE):

DATA RATE: 110, 300, 600, 1200, 2400, 4800, 9600 BAUD

PARITY: odd, even, or none

STOP BITS: 1 or 2

LOGIC LEVELS: RS232, TTL, or 20 ma loop

PRICE: \$400



**ACT 2** The plot thickens. For remote communication to a central processor MICRO-TERM introduces the ACT-II. The ACT-II includes all of the desirable features of the ACT-I with the important addition of an integral originate—only 300 baud modem and acoustic coupler for a standard telephone handset. The ACT-II (without monitor) ships easily into a briefcase (4x14x11) and readily commutes with you.

The ACT-II's modem features 5 stages of active filtering as well as one passive stage to achieve the lowest possible error rates despite the noises present on Ma Bell's lines.

Want true CPU power for low cost? Investigate the time-sharing systems in your area; the ACT-II can be your key to the tremendous libraries of debugged, documented, software which are available on these dial-up systems.

PRICE: \$550.

**ACT 3** Not to be upstaged by its exciting predecessors, the ACT-III performs with state of the art elegance and versatility. The ACT-III includes switch selectable display formats: 24 lines of 80 characters; 48 lines of 40 characters; or 96 lines of 20 characters. Transmission is also switch selectable between three modes: character, line or page at a time mode. The PRINT key sends the contents of the 1920 character display memory out an RS232C printer port at rates up to 9600 baud. For optimum efficiency, trailing spaces on any display line are excluded from transmission and of course the printer rate is independently switch selectable.

Full cursor control, direct cursor addressing, protected data fields, and video inversion are all standard encodeable functions. Convenience features such as a video monitor AC power outlet and a switch to initiate a comprehensive terminal self test are available on the cabinet rear. The ACT-III is the most complete video terminal available at a price far below that of the competition, smart and dumb alike.

PRICE: \$700.



## GENERAL INFORMATION

All MICRO-TERM products are fully assembled, tested and guaranteed for 90 days. The MICRO-TERM product line is available from stock at discriminating computer stores or may be purchased directly from the factory (30-45 day delivery). Prices are F.O.B. St. Louis, Mo. excluding video monitors. Optional high resolution video monitors are available from the factory beginning at \$125.00.

BankAmericard and Master Charge accepted.



MICRO-TERM INC.  
PO. BOX 9387  
ST. LOUIS, MO 63117

PYRAMID FILMS Presents  
**BASIC COMPUTER TERMS**



A New Film by RENAN PRODUCTIONS

A get-acquainted-with-computers film that uses comedy to lead beginners through basic computer parts and terms. Shows how computers work and how easy they are to use. For training programs, medical and business personnel and reassuring the general public about this new time-saving tool.

16 min/color with study-guide  
Sale \$250 Rent \$30  
16mm, super 8 mm or videocassette

To order, phone or write

**PYRAMID FILMS**  
BOX 1048, SANTA MONICA, CA 90406 • 213/828-7577

CIRCLE INQUIRY NO. 50

# COMPUTER CONTROLLED PLOTTERS!!



**90% ASSEMBLED**

11 x 17 inch size (Delivery stock) .....\$750

17 x 22 inch size (Delivery 3-8 weeks) .....\$895

Owner's Manual (refunded with plotter purchase) .....\$5

- We supply plotter and interface -
- You supply computer and software -
- Dealer inquiries invited -

**WRITE TODAY!!**

**Sylvan Hills Laboratory, Inc.**

#1 Sylvanway, Box 239 Strafford, Mo. 65757  
417-736-2664

CIRCLE INQUIRY NO. 55

analyzer reports power in the "X" cycle result when the fluctuations are "X" times 62.5 Hz.

The abbreviation Hz, standard designation for cycles per second, honors Heinrich Hertz, a German Physicist who made major contributions to understanding electromagnetic fluctuations. Maybe some day the abbreviation "T" will represent a unit of speech intelligibility in honor of the "Thinker Tinkers" and their success with voice-commanded computers!

## SPECTRUM ANALYZER EXAMPLES

I used myself as a subject for the data analyzed in even-numbered Figures 2 to 12. The oscilloscope was adjusted to show the entire data frame in each instance. The time base of the oscilloscope does not matter so much as the sampling interval. These samples represent 0.016 second of speech or 0.002 second per major division of the display. It is very difficult to control one's voice well enough to see such waveforms with an analog input to the trigger of the oscilloscope. With sampled digital data and a computer-synchronized trigger, the display is easy to read.

This display hides a fact that can deceive if ignored: Try listening to the sampled sound one time through an audio system output for 0.016 second. You will hear a very short beep and no more. Now try a program loop which does the output again as soon as it finishes. You will hear a steady tone that reminds you of the oral vowel. Actual speech is composed of a changing spectrum. The sampled data frame has only one spectrum which goes on, and on, and on . . . Many consecutive samples of speech must be analyzed to allow the computer to understand changing spectra. This subject belongs to future articles.

The sampling rate of 8000 per second gives a spectrum from 0 to 4000 Hz. This adequately covers the highest frequency of the vowel sounds I produced. Remember that the digital technique will produce wrong answers if the sampled frequency is so slow that there are fewer than two samples per cycle. With all these choices, the spectrum of the vowels is presented in odd-numbered Figures 3 to 13 with the oscilloscope speed adjusted in each instance to present the 64 independent frequency measurements. The major divisions of the 4000 Hz frequency range occur 500 Hz apart. The vertical divisions occur 12 decibels apart, meaning that a power change of a factor of 16 suffices to cause a measurement change of one vertical division.

The twelve figures show data frames from the five vowels, with each data frame followed by its spectrum. The vowel "A" is sampled twice to show the type of variability that occurs. The first data frame in Figure 2 was taken about ten minutes before the data frame in Figure 12. The data frames do not look very similar, but the corresponding spectra in Figures 3 and 13 do show a strong similarity. Each spectrum has a major component at 312 Hz, a second strongest component near 2250 Hz, and third and fourth strongest components at 2500 Hz and 3062 Hz.

Compare the two versions of the spoken vowel "A" with the data frame from that for "E" shown in Figure 4 and its spectrum in Figure 5. Note the similarity of the sampled frames of data. The spectrum of "E" has a first maximum at 187 Hz, followed closely by another at 375 Hz. This may be a dual tone compared to the single tone of "A" at 312 Hz. Six more large components of "E" occur at 2187 Hz, 2375 Hz, 2562 Hz, 3062 Hz, 3250 Hz,

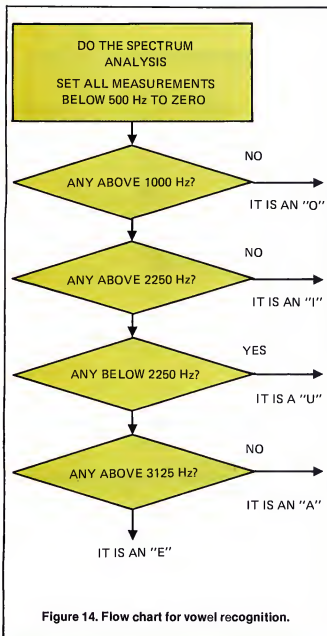


Table I. Basic Relationships of Spectrum Analyzer Control Variables

The aliasing frequency ( $F_A$ ) is half of the sampling frequency ( $F_S$ ):  $F_A = F_S/2$

There are half as many frequency measurements ( $M$ ) as there are samples ( $N$ ) of the fluctuations:

$$M = N/2$$

The bin width ( $B$ ) is the aliasing frequency ( $F_A$ ) divided by the number of frequency measurements ( $M$ ):

$$B = F_A/M$$

By substitution, also:

$$B = 2F_A/N$$

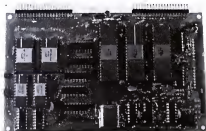
$$B = F_S/N$$

## SUPER JOLT

features TINY BASIC, ASSEMBLER and DEBUGGER ROMs on board!

READY TO RUN IMMEDIATELY! CONNECT THIS CARD TO MOST ANY TERMINAL AND YOU'VE GOT ALL THE MICROCOMPUTER HARDWARE AND SOFTWARE PROGRAMS YOU MAY EVER WANT.

ON ONE SINGLE 4 1/2" x 7" PC CARD YOU GET ALL THIS:



### FULLY ASSEMBLED AND TESTED

- 8-bit 6502 processor
- 1,024-byte static RAM
- 32-bit bidirectional, programmable I/O lines
- 1 MHz crystal controlled clock
- interval timer
- 4 interrupts, including timer and non-maskable
- 3 serial interfaces: 20 mA current loop, RS 232 and TTL
- 5,120 bytes resident ROM software including a single pass symbolic assembler, a TINY BASIC and a Debug Monitor

AVAILABLE NOW. \$375 without assembler and TINY BASIC ROMs, \$575 with. ORDER DIRECT or at participating computer stores. Other systems, cards and kits also available from \$96.

MICROCOMPUTER ASSOCIATES, INC.  
2589 Scott Blvd., Santa Clara 95050

CIRCLE INQUIRY NO. 28

# Thinker Toys™



Your single source for the most advanced S-100 components available:

- ★ Guard your Altair, IMSAI or custom system against program crashes with **CONSTANT VOLTAGE POWER SUPPLIES**, special 12 and 20-amp models from Parasitic Engineering.
- ★ **INTEGRATED CPU/FRONT PANEL** gives you access to all 8080 registers, I/Os and memory from octal keyboard and digital LEDs ... by Morrow Micro-Stuff.
- ★ **WunderBuss with Noise-guard™** is the only 20-slot S-100 bus-board with two-way squelching.
- ★ **TOTAL I/O BOARD** for \$120! 3 cassette channels with control, RS232/TTY port, parallel port, memory.
- ★ Write for specs.

**Thinker Toys™**

505 Arlington  
Berkeley, Ca.  
94707

photo - courtesy Peter Hollenbeck, Byte Shop Berkeley

CIRCLE INQUIRY NO. 44

## 16 K RAM

- IMSAI/ALTAIR/S-100 bus compatible.
- 100% FACTORY BURN IN of memory chips (168 HOURS).
- Low power schottky TTL IC'S used throughout. Power consumption less than 475ma total.
- 350 ns dynamic memories standard. Transparent refresh. No processor wait. Reliable, high-speed, low power clocking and control provided on board. FULL DMA CAPABILITY.
- Kit supplied with full assembly instructions. Sockets supplied for all IC's. All parts prime tested.
- Board addressing permits independent assignment of each 4K block.

**\$299 KIT**  
**Assembled \$385**



WE SUGGEST that you order early. All orders will be shipped on a first-come basis. You may call your Master Charge or Bank Americard order to (805) 937-7951. Personal checks require 2-3 week waiting period. NO COD's. California residents add 6% tax. Foreign order in U.S. funds only.

**VANDENBERG DATA PRODUCTS**

PO BOX 2507  
SANTA MARIA, CALIFORNIA 93454

805-937-7951

### CIRCLE INQUIRY NO. 60

and 3687 Hz. This very complicated spectrum has frequencies approaching the aliasing frequency and many more components than the spectrum of "A". I need to analyze a large number of spectra in various states of my well being to determine whether I have sufficient control to maintain recognizable differences between "A" and "E". Then I will have to produce a computer algorithm capable of recognizing the distinguishing differences. Now one can sympathize with the engineer of HWIM who has spent five years with only three male American speakers!

Figure 6 shows the sample of fluctuations of the spoken vowel "I", with its spectrum in Figure 7. The character of the data frame is not clearly unique, and the major component of the spectrum is again at 312 Hz. The spectrum differs between 321 Hz and 2000 Hz, with components at 937 Hz, 1375 Hz, 1875 Hz, and 2187 Hz, where there were none for vowel sounds "A" or "E". This clue suffices for easy computer recognition of the vowel. More analyses will probably ensure that the difference is consistent. Measurements have appeared near 312 Hz for each vowel. Maybe 312 Hz is the basic frequency of my voice and should be ignored in distinguishing vowels.

Figure 8 shows the sampled sound for the vowel "O", with its spectrum in Figure 9. The basic frequency of 312 Hz appears with one or maybe two low-power frequencies at 500 Hz and 687 Hz. Some higher frequencies are at least 20 decibels lower. This spectral simplicity makes it easy to distinguish an "O" from the previous vowels. Note that the sampled data frame is much smoother. The reduced high-frequency content produces a smoother fluctuation. The vowel might be distinguished from "A" "E", and "I" by the sampled data alone, without a spectrum analyzer.

Figure 10 shows the sampled data frame from the vowel "U", with its spectrum in Figure 11. The smooth waveform shows that a spectrum analysis is needed to distinguish "U" from "O". The spectrum shows clear components at 1250 Hz, 2437 Hz, and 2937 Hz in addition to 375 Hz. The smooth fluctuations with higher frequencies present suggest that all frequencies are harmonics. This suggestion is not apparent from what has been shown here, but it is apparent after experimentation with spectrum analysis of many different fluctuations. This harmonic nature of "U" may provide a clue for recognition of the vowel. The speaker's voice control will need further understanding before the method can be developed and tested.

Table II organizes the variety of measurements made with the vowels across the top and the 64 frequency bins down the left side. Below each vowel, an X marks a frequency observed for that vowel. Using this table of measurements, one can systematically observe these differences and can form a theory of how to differentiate between the vowels. Several systems might be tried. The simplest is probably best.

Figure 14 shows a flow diagram of a possible scheme for distinguishing between the vowels I spoke. It is easy to test the flow chart by using it to analyze the spectra in Figures 3 to 13.

This is all that I have to offer hobbyists of voice-commanded computers, to date. I hope experts in other fields will make an effort to explain their studies in simple terms. I am sure that physiologists know much pertinent information not included in this article. Linguists have studied the subject also. The skills and time of "Thinker Tinkers" with stimulation and assistance can produce exciting results.



# Subsystem "B" makes the computer you already have work almost as well as a new Sol-20.

**Add it now, and for a limited time we'll throw in a new module with 2048 bytes of preprogrammed PROM or ROM and 1024 bytes of RAM memory free!**

Processor Technology's Subsystem "B" puts together the major system elements you need to get your Altair or IMSAI up and running.

You get both RAM and PROM memory, parallel, serial, cassette and video display interfaces, and software. Software includes a bootstrap loader program so you can load any Processor Technology CUTS ("Byte/Kansas City") 1200 BAUD cassette tapes. Standardized subroutines in ROM, similar to those in a Sol personality module, are used by many Processor Technology software packages to improve program efficiency. You'll find you rarely need to touch your front panel switches. With our Subsystem "B" you are up and running as soon as you turn on the power.

Three subsystems are available, depending on your memory requirements. Each Subsystem "B" includes five S-100 bus compatible modules as listed below. Each is dependent upon our new GPM module (GPM = General Purpose Memory) which provides 1024 bytes of low power static RAM and 2048 bytes of preprogrammed ROM or EPROM as well as space for up to 8192 bytes more of ROM or 2708 type EPROM. The GPM module accepts the new ROM version of our well known ALS-8 Editor/Assembler software package.

With Subsystem "B" you have guaranteed compatibility with all Processor Technology software and hardware products.

Subsystem Model	B70	B110	B190
Total memory provided (bytes)	7168	11264	19456
Display I/O	VDM-1	VDM-1	VDM-1
Parallel, Serial I/O	3P+S	3P+S	3P+S
Tape Cassette I/O	CUTS	CUTS	CUTS
Memory	4KRA	8KRA	16KRA
Price	\$594	\$730	\$964

NOTE: The GPM module with both RAM and PROM is included FREE in all the above subsystems. The GPM kit is \$129 if purchased separately.

The ALS-8/ROM chip set is \$159. SIM-1 & TXT-2/ROM add-on set is \$60 and requires both GPM and ALS-8/ROM.

## I want Subsystem "B" to get my Altair or IMSAI up and running.

- ☐ Enclosed is a check for \$\_\_\_\_\_ I want:  
 California residents add 6% sales tax. ☐ B70 at \$594  
 No shipping charge. ☐ B110 at \$730  
☐ Mastercharge # \_\_\_\_\_ ☐ B190 at \$964  
 (include Interbank No. and expiration date)  
☐ Send more information

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_



6200 Hollis Street, Box G  
 Emeryville, CA 94608 (415) 652-8080

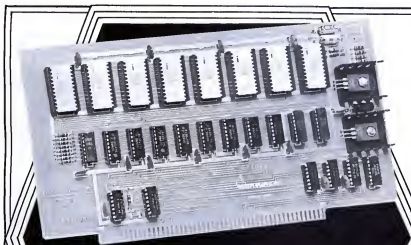


TABLE II. SUMMARY OF VOWEL FREQUENCIES

Hz	A	E	I	O	U
62.5					
125					
187.5		X			
250					
312.5	X		X	X	
375		X			X
437.5					
500				X	
562.5					
625					
687.5				X	
750					
812.5					
875					
937.5			X		
1000					
1062.5					
1125					
1187.5					
1250					X
1312.5					
1375			X		
1437.5					
1500					
1562.5					
1625					
1687.5					
1750					
1812.5			X		
1875					
1937.5					
2000					
2062.5					
2125					
2187.5		X	X		
2250	X				
2312.5					
2375		X			
2437.5					X
2500	X				
2562.5		X			
2625					
2687.5					
2750					
2812.5					
2875					
2937.5					X
3000					

TABLE II. (Continued)

Hz	A	E	I	O	U
3062.5	X	X			
3125					
3187.5					
3250		X			
3312.5					
3375					
3437.5					
3500					
3562.5					
3625					
3687.5		X			
3750					
3812.5					
3875					
3937.5					
4000					



# THE VECTOR 1 Reset and Go PROM/RAM BOARD

from

**VECTOR GRAPHIC**

**PROM:** Space for 2K bytes, 1702A. Store bootstrap loaders and monitors.

**RAM:** 1K bytes, 2102LIPC, 450 ns, low power. NO NEED TO RELOCATE STACK WHEN ADDING MEMORY.

**CIRCUITRY:** Replaces memory write logic on ALTAIR™ and IMSAI front panels.

**REGULATORS:** Two regulators. No need for regulated power supply.

**JUMP-ON-RESET:** PROM program execution starts at any location in memory without interfering with programs in any other portion of memory.

S-100 BUS; +8 and -16 VDC; P/C BOARD SOLDER MASKED BOTH SIDES WITH PLATED THROUGH HOLES; ALL SOCKETS INCLUDED.

**OPTIONAL FIRMWARE:** 512 byte monitor for use with Tarbell tape interface on 2, 1702A PROMs.

<b>PROM/RAM KIT WITHOUT PROMS</b>	<b>\$ 89</b>
+ OPTION A - SIO Rev. 1 or 3 P + S	\$129
+ OPTION B - 2 SIO (MITS)	\$129
+ OPTION C - SIO 2 (IMSAI)	\$129
+ OPTION D - Poly Video Interface (Includes Video Driver)	\$159

California residents please add 6% tax.

**IMMEDIATE DELIVERY FROM FACTORY OR YOUR LOCAL COMPUTER STORE**



**VECTOR GRAPHIC INC.**  
T.M.  
717 LAKEFIELD ROAD, SUITE F • WESTLAKE VILLAGE, CA 91361 • (805) 497-0733

## PRODUCT PREVIEW

# MULTI-TYME™

### System Employs 880 Microcomputer for Timekeeping and Security Operations

by Michael di Meo

#### NO TIME CLOCKS

"MULTI-TYME™" is a computerized system which enables a company, plant or institution to initiate and administer a policy of flexible working hours for its employees. The computerized input provides automatic feed of all time and attendance data to the payroll accounting system.

#### SECURITY SYSTEM

Additionally the same installation processes security information from ingress and egress ports of the plant, from fire and flood detection equipment, regulates temperature conditions and monitors power failures.

Cardkey Systems, a division of Greer Hydraulics, Inc. designed this system around two of the company's products, the Interrogator 880 microcomputer system

and the company's standard Cardkey Securiti-Card® latching device. The peripherals were supplied by Digital Equipment Corporation.

#### HISTORY OF THE CONCEPT

Time and Motion Studies in a number of industrial countries have revealed a steadily declining rate of growth in worker productivity. This can be partially alleviated by management experimentation in flexible working time where employees set their own work hours within limits established by the employer.

The first flexible working hours system was introduced only nine years ago in a Messerschmitt plant in Munich, West Germany in response to traffic congestion problems during peak hours. The aerospace firm permitted its 2000 employees to stretch out their arrival and departures over a prescribed band of time in the morning and evening, start and finish work at their discretion as



Figure 1. MULTI-TYME™ monitors and operates both flexible and fixed working time systems in almost any installation or facility—government, business, industrial, financial, institutional—without time clocks, time cards or other conventional timekeeping equipment. The system includes video displays, hard copy printer (right) and a processor (left) which automatically feeds all time and attendance information directly into the payroll system.

Introducing the Micropolis MetaFloppy.<sup>™</sup> The first system that actually combines the high-capacity storage of an 8" floppy with the low cost and convenience of a 5 1/4" format.

Metafloppy goes far beyond any ordinary floppy. Giving you the lowest obtainable cost per thousand bytes of floppy disk storage. From anyone. Or anywhere.

In fact, there's really no comparison. An ordinary 5 1/4" floppy provides just 70K (or so) bytes of storage. Not nearly enough for meaningful work.

Metafloppy, instead, packs each disk with a whopping 315K bytes of storage! The true equivalent of any typical 8" floppy. And over four times the capacity of a typical 5 1/4" floppy. (We call it "quad" density.)

Best of all, Micropolis delivers everything you need — the

drive, S-100 controller, interface cable, power supply, even extended BASIC software — all for an unbeatable \$1095.

Or save \$150 and buy a Micropolis "double" density drive instead. You get the same complete package but with 143K bytes of storage per disk. That's still twice the capacity of a typical 5 1/4" floppy. And twice the buy.

For maximum convenience — and savings — both densities are also available in dual drive models.

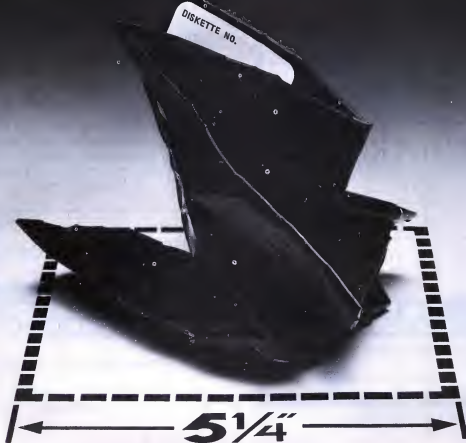
But then, at Micropolis our goal is to give you twice the bytes per buck. And today, it's quite literally the very least we can do.



## MICROPOLIS<sup>™</sup>

In the U.S., please contact:  
Micropolis Corporation, 9017 Reseda Blvd.  
Northridge, California 91324 (213) 349-2328

**It's one thing to get  
an 8" floppy into a 5 1/4" format.  
It's another thing to  
do it without spending a wad.**



YOU'VE SEEN THIS PRINTER  
AT TWICE THE PRICE...



NOW ONLY \$296.00\*  
NEW! NOT USED! COMPLETE!  
EXPANDOR PRINTER

- Operates at 10 CPS
- Prints 80 positions wide—10 CPI
- Pin feed platen included
- 8 Bit parallel interface included
- 64 Character ASCII code set

(P.S. It's compatible with the PortaCom.)

Cover Optional at \$29.50

\* Pa. residents add 6% sales tax.

CHECK...MONEY ORDER...BANK AMERICARD...  
MASTERCARD

EXPANDOR INCORPORATED  
Dept. 222, 612 Beatty Road,  
Monroeville, Pa. 15146  
Telephone: (412) 373-0300

CIRCLE INQUIRY NO. 101

## Introducing Equinox 100™ computer kit



## THE FRONTRUNNER

Equinox 100™ is the 8080 CPU/5-100 Bus computer kit that's years in front of Altair™ and IMSAI in design, function and front-panel programming capability. Equinox 100 is easier to build, easier to program, easier to expand in the future and completely debugged right now. After all, it's from Parasitic Engineering, the leading supplier of debugging kits for the Altair® 8800. Before you invest in any micro-processor kit, discover the new Equinox 100!™ At \$699, it's clearly **The Frontrunner**. Write for free specs to Parasitic Engineering, P.O. Box 6314, Albany, CA 94706.

# EQUINOX 100

The Frontrunner from Parasitic Engineering



\*A trademark of MITS Inc.



CIRCLE INQUIRY NO. 102

long as they completed the total number of hours required for a total pay period. All workers, however, must be present during so-called "core times," usually a two- or three-hour period before and after lunch break.

Traffic conditions improved and some unexpected side-effects appeared. Overtime declined by 50 percent, absenteeism dropped 40 percent, employee morale rose, reflected by diminished employee turnover and reduced tardiness.

In the intervening years the same results were achieved virtually everywhere the flexible hours system was introduced.

The principle obstacle to widespread introduction of the flexible hours concept in the United States was caused by the limitations of timekeeping equipment which necessitated manual transcription of recorded time data. Inexpensive computerization changed the picture.

The MULTI-TYME™ system provides the answer. It is the first timekeeping system which can simultaneously keep track of both flexible and fixed working time environments and has output capabilities to interface with automated payroll systems. MULTI-TYME™ electronically records and maintains a record of all employee entry and exit times from data received from the badge readers. The data are processed for routing through the 880 to the storage files and/or video display.

The processor is programmed with the cardholder's personnel and payroll information. His in/out activity and total hours to the minute are accumulated in the file and sorted, the resulting data on mag tape become the entry to the company's payroll accounting system.

Card transactions during invalid times—late arrivals, early departures and other periods monitored for a variable working hours environment—are recorded as exceptions and can be displayed at the time of occurrence.

One or more CRTs may be used to examine data in the employee file. The CRTs can be used in an interactive mode to make adjustments in the record for such changes as sick time, vacation and holidays.

Employees may also access the system to obtain work record information, but this display operates in the display mode only. The employee has no ability to modify the data.

The printer terminal is used to generate printed records for tax information and management use. In addition to weekly attendance recording, the MULTI-TYME™ installation functions as an instant source of identification for any available group within the work force and can be used to eliminate imbalances created by absences and tardiness where work pileup or unnecessary idle time would result.

WE'RE FIGHTING FOR YOUR LIFE

## Eat Less Saturated Fat

American Heart Association



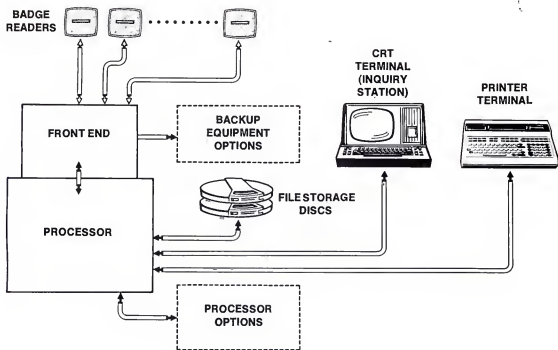


Figure 3. Typical MULTI-TYME™ Hardware Configuration.

## COMPUTER MUSIC WITH OR WITHOUT THE COMPUTER !

### EQUALLY TEMPERED DIGITAL TO ANALOG CONVERTER

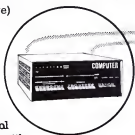
The PAIA 8780 kit is based on a multiplying principle that allows the module to generate the exact exponential stair-step function required to make even the simplest linear response oscillators and filters produce equally tempered musical intervals. The 8780 uses only six bits of data to generate over 5 octaves of control voltage. In an 8 bit system the remaining two bits are ordinarily reserved for trigger flags, but may be used to extend the range of the converter or provide micro-tonal tunings.

The module is physically and electrically compatible with the complete line of PAIA music synthesizer modules and is easily interfaced to any micro-processor with or without hand-shaking logic.

#8780 D/A CONVERTER Kit ..... \$34.95  
(plus \$1.00 postage)

#### WITH A COMPUTER

Both the 8780 D/A and the 8782 Encoded Keyboard easily interface to any processor providing capabilities and control never before possible with music synthesizers.



### THE PAIA HIGH LEVEL LANGUAGE FOR COMPUTER MUSIC DATA ENTRY (We call it a keyboard)

An 8 key roll-over scanning matrix encoder tied to a 37 note AGO keyboard provides 6 bits of data and both STROBE and STROBE control outputs. Input control lines to the encoder include SCAN (starts and stops encoder clock), RESET, START and RANDOM making the keyboard universally applicable to all computer/processors from the very largest to the very smallest.

Housed in a trim and sturdy vinyl covered road case, the kit consists of all parts including keyboard, power supply and detailed assembly instructions; software overview for computer applications and detailed instructions for Digital Sample and Hold.

#8782 ENCODED KEYBOARD .. \$109.95  
(shipping wt. 20 lbs. - shipped freight collect)

DETAILS  
ON THESE & MORE  
IN OUR FREE CATALOG

**PAIA**  
ELECTRONICS, INC.



#### WITHOUT A COMPUTER

An infinite hold, DIGITAL Sample and Hold and the heart of an entire system of modules that will be introduced over the next few months including: Memories, Polytonic output modules & others.

DEPT. 6-F 1020 WEST WILSHIRE BLVD. OKLAHOMA CITY, OK 73116

CIRCLE INQUIRY NO. 43



# NEW PRODUCTS

## NEW POWER MODULE

Abbott has a new line of low cost AC to DC modular power supplies. The "C" series of the new NL line provides single outputs of 5V/9A, 12V/5A, 15V/4.5A, 24V/3.6A and 28V/3A. Standard input is 115VAC, 47 to 440 Hz with 220 VAC available at no additional cost. Dual primaries are also available. All units feature tight regulation, low ripple and full load operation at 50°C ambient temperature with derating to 40% at 71°C.



Overvoltage protection is standard on 5V outputs and available as an optional feature on the higher voltages. Case size in only 7 x 4 x 2 1/4 inches with mounting on three surfaces. High quality components are used throughout with conservative design margins to assure high reliability and long life under worst case operating conditions.

The NL line also includes single, dual and triple output models with power ratings from 15 to 170 watts. Send for Abbott's new 1976-77 Industrial Power Supply Catalog for complete details on this and other lines of power modules.

Price: \$61.00 (1-24 pieces) Delivery: Normally from stock.

For further information, contact Abbott Industrial Products Division, 639 S. Glenwood Pl., Burbank, CA 91506, Tel. (213)841-2510, Telex 69-6282.

CIRCLE INQUIRY NO. 115

## VIDEO GAME CHIP FOR BLACK-AND-WHITE TV

A new game chip intended for the black and white TV market is now available from National Semiconductor Corporation. The MM5789 is an IC that has tennis, hockey and handball in a format similar to the MM57100, National's color video game chip.

The main difference between the MM5789 and the MM57100, other than color, is in the hockey game. In the MM57100, downfield players engage in random blocking to protect each player's goal. With the MM5789, the downfield players are controlled by the player's paddle.

The game chips may also be integrated directly into a TV set without going through the antenna, requiring only two chips instead of three. The MM5789 generates the composite

video, and the MM53104 operates directly with a 3.58 MHz crystal. To accomplish this, the video signal is inserted into the television set at a point after the video detector and the audio are switched into the sound section of the set. In this way, an ordinary black and white TV set may be modified to include games by adding a multipole switch power supply, game chipset and components, and a push-button switch to select the game.

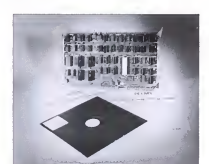
An external RC network, consisting of a fixed capacitor and a variable resistor, gives the vertical paddle positioning. Moving to the top or bottom boundary and pressing the reset button or an external button will change the paddle size. The games are selected in sequence by pushing a button. The score, presented numerically on the TV screen, is blanked automatically when the ball is put into play.

For further information, contact National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051, Tel. (408)737-5000.

CIRCLE INQUIRY NO. 116

## RELMS Z80 SYSTEM ADAPTOR MODULE ENABLES MDS-800 TO SUPPORT AND DEVELOP 8080 AND Z80 HARDWARE/SOFTWARE

For designers wanting the additional capability of the Zilog Z80 but tied to MDS-800 hardware and 8080 software, Relational Memory Systems, Inc. (RELMS) announces the Z80 System Adaptor Module, Z80-SAM. Completely hardware and software compatible with the 8080, 8080A, 8085 and Z80 Microprocessors, the Z80-SAM enables an MDS-800 to support and develop both 8080 and Zilog Z80 software for a fraction of a new Development System's cost.



The Z80-SAM contains a single board and associated software and firmware. The SAM Microcomputer Board supplants the corresponding MDS-800 board.

Besides the hardware board, Z80-SAM System Monitor PROM firmware replaces corresponding MDS-800 ROM firmware (on Monitor PROM Board). Software consisting of a 16K DOS Assembler is added to existing MDS software. Software will be available shortly to support ICOM Diskette systems with the MDS-800.

Most notably, the Z80-SAM extends the useful life of the capital investment 8080 users have in their MDS-800 System while enabling the user to utilize the faster, more efficient Z80

microprocessor in future hardware/software development.

In addition, the SAM Z80 Assembler facilitates software development in that it operates four times as fast as the 8080 Assembler on the MDS-800. Moreover, the user can ease program development by patching Z80 code into existing 8080 code via the Z80-SAM.

Enhanced debugging capability is afforded by hardware features such as display LED's and single cycle switch which allow the user to freeze the MDS-800 data bus, examine the bus contents, and single-step the program.

A more powerful set of Monitor PROM commands improves both program debug and development capability. The monitor permits a masked 8-hexadecimal digit string memory search. It displays all Z80 registers and enables a specified memory-word or register bit to be set, cleared or displayed.

To eliminate the chore of entering repeatedly by hand a set of console commands, the Monitor PROM permits the sequence of commands to be written into memory and later retrieved when needed and executed.

Central to the expanded capability of the Z80-SAM is the Z80 Microcomputer Board. A quality of the Z80 microcomputer which affords significantly increased programming efficiency while reducing effort is its large 168-command instruction set.

The instructions permit combinations of addressing modes in a single instruction and "block moves and searches" of up to 65K of data with one instruction. The instructions permit relative, indexed, and modified page zero addressing.

Beyond the instruction set, the microcomputer contains additional hardware which facilitates the programming effort. Two 16-bit index registers enable index addressing while an extra 8-bit accumulator permits 16-bit arithmetic. Moreover, twice as many general purpose registers are available to the user as in the 8080.

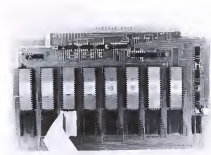
Price and Delivery: The Z80-SAM is priced at \$1495 in single-unit quantity and includes the Z80 Microcomputer Board, Monitor ROM Board, and Z80 SAM Assembler on diskette. OEM quantity discounts are available. Delivery is immediate from the factory.

For further information, contact Douglas B. Kelley, Director, Sales/Marketing, Relational Memory Systems, Inc. (RELMS), P.O. Box 6719, Santa Clara, CA 95150, Tel. (408)248-6356.

CIRCLE INQUIRY NO. 117

## 9620 INTERFACE MODULE WITH 16 PARALLEL I/O PORTS

The 9620 is a parallel interface module specifically designed for compatibility with the M6800 Microprocessor Bus. It is pin and outline compatible with the Motorola EXORCISER, Micromodule\*, the MEK6800D1 and MEK6800D2 Evaluation Kits, and other industry standard cards. It features full address decoding and fully buffered data, address and control lines. This module utilizes 8 MC6820 Peripheral Interface Adapters mounted in sockets, each with its own flat cable connector. Sixteen parallel I/O ports are therefore provided on a single card.



The 9620 occupies 32 sequential memory addresses. The 16 PERIPHERAL DATA/DATA DIRECTION REGISTERS and the 16 CONTROL REGISTERS are sequentially arranged to permit the use of a very tight polling loop in interrupt-driven systems. This arrangement also allows indexed addressing to improve coding efficiency for multichannel I/O systems.

The 9620 is the newest member of a family of M6800 Support Modules. All cards of the Family are 6.05 inches by 9.75 inches and utilize a 43-pin dual readout connector with 0.15625 inch pin spacing.

The 9620 is priced at \$375 in single quantities and \$225 in lots of 100. Delivery is two to four weeks from factory stock. For further information contact CREATIVE MICRO SYSTEMS, 5231 Loyola Ave., Westminster, CA 92683; phone (714) 892-2859.

\*Trade Mark of Motorola, Inc.

CIRCLE INQUIRY NO. 118

### Portable Data Logger Scans 8 Times Faster

A new series of low-cost, lightweight, all-weather battery-operated data acquisition systems with operating speeds up to 32 samples per second and storage capacities exceeding 10 megabits on a standard 300-foot Phillips-type digital cassette.



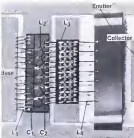
High scanning rates are attributable to a unique 8-phase driver for the high-resolution stepping motor in the incremental tape recorder. The new recorder allows an 8-channel scan interval of 250 milliseconds as opposed to the 2-second scan interval of other portable loggers currently on the market. On a single battery charge and without changing cassette, the Sea Data unit can record 536,000 12-bit data words, plus 67,000 36-bit headers (including elapsed time).

For further information, contact Sea Data Corporation, 153 California Street, Newton, Massachusetts 02458; Telephone (617) 244-3216.

CIRCLE INQUIRY NO. 119

### High Technology RF Transistors Increase Output Power at UHF

A series of new RF power transistors that extends RF power output capabilities to 80 Watts in the 100 to 500 megahertz range has been introduced by Motorola.



The devices are designed for broadband operation as Class A, AB, B and C transmitter amplifiers in UHF communications equipment operating from a 12-28 Volt power supply. One primary application is expected to be in Military Aircraft Radios.

To achieve the reliability required for military applications, an all-gold metallization system is employed for all devices. Gold is used for the top metal of the transistor, for the associated MOS capacitors, for the bonding wires, as well as for package plating. The reliability advantage achieved results from the elimination of "aluminum migration" and corrosion due to contact of dissimilar metals.

The new devices are available from OEM stock and from Motorola distributors.

For further information, contact Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, Arizona 85036, Phone 244-6900.

CIRCLE INQUIRY NO. 120

### Dual Seven-Segment Displays

The .3 inch red, two-digit displays are designed especially for Citizen Band channel indicators, electronic games, Industrial Instrumentation, television set channel indicators and for appliances such as microwave ovens, clothes dryers and washers.



The TIL807 display has a common anode; the TIL806 has a common cathode. Besides being low in cost, they feature high brightness, typically 500  $\mu$ cd per segment at 20mA.

The displays have a rugged, lead frame construction with bottom pins for an easy mounting, plug-in package. Pin spacing is .08 inch for insertion in mounting hole rows on .5 inch centers. Besides rugged construction, these devices have wide viewing angle.

The package is .6 inch high by .7 inch wide and has two .3 inch high characters, providing compact packaging with high reliability.

Prices for either type are \$3.84 each in up to 100 quantities and \$2.88 each in quantities above 100 to 999.

For further information, contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: TIL807, 806), Dallas, Texas 75222.

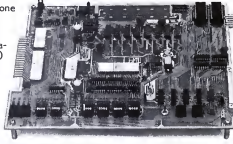
CIRCLE INQUIRY NO. 121

### HEX Breadboards Available for PDP-II & PDP-8/A Users

The availability of a complete line of breadboards in the HEX pattern, designed for compatibility with Digital Equipment Corporation's PDP-II & 8/A minicomputers, is being announced by Douglas Electronics.

## If you want a microcomputer with all of these standard features...

- 8080 MPU (The one with growing software support)
- 1024 Byte ROM (With maximum capacity of 4K Bytes)
- 1024 Byte RAM (With maximum capacity of 2K Bytes)
- TTY Serial I/O
- EIA Serial I/O
- 3 parallel I/O's
- ASCII/Baudot terminal compatibility with TTY machines or video units
- Monitor having load, dump, display, insert and go functions



- Complete with card connectors
- Comprehensive User's Manual, plus Intel 8080 User's Manual
- Completely factory assembled and tested—not a kit
- Optional accessories: Keyboard/video display, audio cassette modem

interface, power supply, ROM programmer and attractive cabinetry...plus more options to follow. Tel: MCEM-8080, \$375

## ...then let us send you our card.

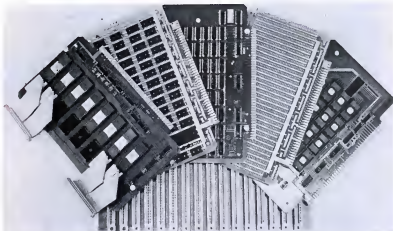
HAL Communications Corp. has been a leader in digital communications for over half a decade. The MCEM-8080 microcomputer shows just how far this leadership has taken us...and how far it can take you in your applications. That's why we'd like to send you our card—one PC board that we feel is the best-valued, most complete



microcomputer you can buy. For details on the MCEM-8080, write today. We'll also include comprehensive information on the HAL DS-3000 KSR microprocessor-based terminal, the terminal that gives you multi-code compatibility, flexibility for future changes, editing, and a convenient, large video display format.

**HAL Communications Corp.**  
Box 365, 807 E. Green Street, Urbana, Illinois 61801  
Telephone (217) 367-7373

## We'll Stack The Deck



## IN YOUR FAVOR

with our Family of EXORciser\* compatible cards.

The 9600 Family of Support Modules is a set of generalized building block hardware designed around the M6800 Microprocessor. The cards are pin and outline compatible with the Motorola EXORciser\* and Micromodules,\* the MEK6800D1 and MEK6800D2 Evaluation Kits, and with other industry standard cards.

## HERE'S OUR DEAL

We'll save you time and money with our low cost, ready-to-use Support Modules. Use them to build your data communications, industrial control, or other microprocessor-based system and give it personality with software or plug them into your EXORciser\* to expand memory and I/O capacity.

Support Module	1-4 Price	100 Price	Delivery
9601 16 Slot Mother Board	175.00	105.00	NOW
9602 Card Cage	75.00	45.00	NOW
9610 Utility Prototyping Board	36.00	21.80	NOW
9615 2K EPROM PROM Module	35.00	21.80	NOW
9615K 4K EPROM Kit of Parts	275.00	165.00	NOW
9620 16 Port Parallel I/O Module	375.00	225.00	NOW
9626 8K Static RAM Module	35.00	21.80	NOW
9626K 8K Static Kit of Parts	175.00	105.00	NOW
9650 8 Port Duplex Asyn. Serial I/O	395.00	237.00	May '77

Plus a pat hand of ten more cards for you to call us on.

We'll mark the deck with your logo and part number if your application requires or if you prefer to deal your own hand, ask about licensing our designs and tooling.

\* Trade Mark of Motorola, Inc.

PLEASE RUSH THE FOLLOWING ORDER TO:

Quantity _____	Item _____	Name _____
_____	9601 _____	_____
_____	9602 _____	Company (optional) _____
_____	9610 _____	_____
_____	9615 _____	Address _____
_____	9615K _____	_____
_____	9620 _____	City _____ State _____ Zip _____
_____	9626 _____	_____
_____	9626K _____	California residents please add 6% Sales Tax
_____	9650 _____	_____

Send Info. On: \_\_\_\_\_ Amount Enclosed, Check or Money Order: \_\_\_\_\_  
C. O. D. Orders Enclose 20% With Order

## CREATIVE MICRO SYSTEMS

6773 WESTMINSTER AVENUE • WESTMINSTER, CALIFORNIA 92683 • (714) 892-2859

CIRCLE INQUIRY NO. 6



A manufacturer of PDP-8 compatible breadboards and accessories, Douglas is expanding its lines to meet a growing demand on the part of mini users for products which will facilitate the development and expansion of mini-based systems.

The boards offered are all FR-4 glass epoxy with electro-plated solder circuits and gold connector tabs and come in a variety of configurations and options which include extender boards with sockets, wire wrap boards, breadboards for LSI and SSI use, and I/O transfers. The entire series is now available from stock at Douglas Electronics, Inc., 718 Marina Blvd., San Leandro, CA 94577.

CIRCLE INQUIRY NO. 122

## Triple-Output DC/DC Converters For Microprocessors

Scientific Programming Inc., is introducing a new series of low-cost but high-performance miniature DC/DC converters for the microprocessor and semiconductor fields.



The new converters are unusual in that they provide three output voltages (typically +12 V, +5V, and -5V) at high currents to meet the power needs of virtually any microprocessor or RAM device. The converters are thought to be the only ones commercially available that provide three regulated outputs with greater than 75% efficiency.

Recommended use for the converters includes powering microprocessor systems such as the 8080 family, powering EPROMs such as the 2708's, and powering the popular new 16K x 1 dynamic RAMs.

Besides being physically small and low in cost, the new converters have a high efficiency of over 75% at full load. The outputs are regulated for Input ranges from 4 to 6V, a range which enables operation from 4 cells in battery-operated applications. Idle current for the converters is only 15 mA, which is equivalent to 300 hours of continuous operation from typical "D" size batteries.

Physically, the converters are encapsulated in rigid cases 2.25" x 3.25" x 0.45" in size. The small size suits the converters to mounting on standard printed circuit cards.

The converters are available in eight models with a range of output voltages and currents. The most commonly used model provides +5V at 250 mA, +12V at 80 mA, and -5V at 80 mA. Output voltage regulation is  $\pm 5\%$  for the input range from 4 to 6V. Other output voltages such as +5V, +15V, and -5V are also available.

A two-output series offering such outputs as +12V and -5V or +15V and -15V is included in the line.

All converters can be special ordered with the following options: (a) 6V AC input instead of unregulated DC, (b) 80% efficiency instead of the standard 75%, (c) power strobing (TTL and CMOS compatible on/off control for each output).

Prices of the converters range from \$29.95 to \$59.95, depending on quantity. Delivery is from stock to 4 weeks, depending on model. For more information, contact: Scientific Programming Inc., 1499 Bayshore Highway, Burlingame, Ca 94010, (415) 692-1600.

CIRCLE INQUIRY NO. 123

### Archer ASCII Keyboard Encoder

The Archer Project-Board kit is an ASCII (American Standard Code for Information Interchange) Keyboard Encoder.



The completed keyboard encoder can be used to provide inputs to all types of equipment designed to operate with ASCII inputs. For example, it can be used with TV typewriters, mini-computers, microprocessors, electric typewriters, or any other devices which require positive or negative ASCII encoded alpha-numerical characters.

Features of the Archer ASCII Keyboard Encoder include: a repeat key to control all characters and symbols, a negative-going or positive-going data valid strobe, latch outputs (stores last key code), shift and shift lock capability, true or false ASCII outputs and six extra control keys.

The encoder is able to handle an output of 833 characters per minute (CPM) and has a repeat key rate of 206 CPM. An external power source of 5 VDC at about 500 mA is required to power the encoder.

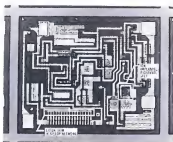
The Archer ASCII Keyboard Encoder Project-Board with complete assembly and parts manual is priced at \$14.95. All parts needed to assemble the encoder, including the circuit board, manual and keyboard, but excluding hardware and case, are available from Radio Shack for \$57.80.

For further information, contact: 2617 West Seventh Street, Fort Worth, Texas 76107, Phone (817) 390-3272.

CIRCLE INQUIRY NO. 124

### Precision Voltage Reference for Instrumentation

A stable 2.5 Volt reference source, type number MC1403/1503 has been designed for critical instrumentation and DA converter applications, the low-cost monolithic circuit features a maximum output voltage variation of only 1% ( $\pm 25\text{mV}$ ) and a typical temperature coefficient of ( $\Delta\text{Vol}/\Delta T$ ) of 10 ppm/°C.



Laser trimming of resistive networks as a routine process during normal manufacture provides a high yield to a very tight tolerance specification. The laser trimming process adds to the probing time and requires a small amount of additional real estate (compared with non trimmed chips) but effectively increases the tolerance yield to the point that the small

cost increase is swamped by the overall cost reductions made possible, compared with device selection to a given spec.

This chip also represents the first utilization of a P-channel J-FET in a linear integrated circuit at Motorola (a relatively new production technology). Ion implantation is the technology responsible for this capability.

Other important circuit specifications include:

Line Regulation = 3mV (max) at input voltage from 4.5 to 15V, 4.5mV (max) at input voltage from 15 to 40 V.

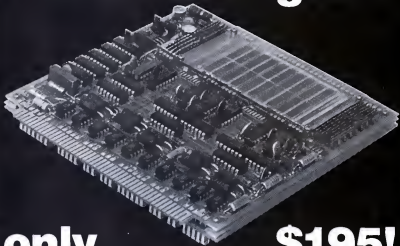
Load Regulation = 10mV (max at output currents from 1 to 11mA).

The devices are immediately available from the Motorola OEM warehouse and from distributor stock.

For further information, contact: Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, Arizona 85036, Phone 244-6900.

CIRCLE INQUIRY NO. 125

## 10,240 bits of core storage...



## only.....\$195!

### Model 620 Core Memory System

- 1024 words x 10 bits
- Access time 350 nsec
- Full cycle 1.0 usec
- Expandable
- Single board, 6.0" x 6.4" on 1.0" centers
- Compatible with wide range of logic levels
- Non-volatile
- Mating connector included
- Technical manual included
- Delivery 10 days



**FABRI-TEK INC.**  
**COMPUTER SYSTEMS**

5901 South County Road 18 • Minneapolis, MN 55436 • (612) 935-8811

### Rush Order Form

**Model 620 Core Memory System, \$195 postpaid in continental USA**

Enclosed is my ☐ cashier's check ☐ money order ☐ personal check



Signature \_\_\_\_\_



☐ BankAmericard No. \_\_\_\_\_

☐ Master Charge No. \_\_\_\_\_

Expires \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

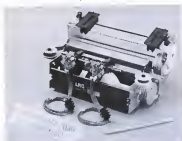
Phone \_\_\_\_\_



## 80 Columns Matrix Printer

C. Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, California 90066, announces a new 80-column, alphanumeric, dot-matrix printer, Model 7080.

The printer is designed for use in micro-computer terminals, data processing systems, communications, and other areas of application, and less complex, compact, and permits the use of a simple electronic interface.



The price for the quantity of 500 units is \$250.00 each. Production quantities are available from August 1977.

For further information, please contact Mr. Ken Hidaka, C. Itoh Electronics, Inc., Los Angeles. Telephone: (213) 390-7778.

CIRCLE INQUIRY NO. 126

## 100% Solid-State Voice Identifier

The ID-200 Automatic Voice Station Identifier uses an all solid-state memory system rather than a mechanical tape transport and achieves an exceptionally high level of reliability. The ID-200 connects to radio transmitters and automatically sends the assigned call letters at the prescribed interval in accordance with F.C.C. regulations.

The ID-200 is actually a complete recorder and play back unit. Identification messages may be recorded and re-recorded at any time with "tape-like" voice quality using an operator headset.

Designed to interface with virtually any base station configuration, the ID-200 includes a programmable timer as well as a busy channel lockout system. The unit may be set to identify after every transmission, every time period which included transmitter activity or every time period, regardless of activity. Transmitter activity is sensed by a contact closure. Co-channel activity is sensed by either a contact closure or an audio signal.

The unit includes a 117VAC power supply and comes equipped for rack mounting.

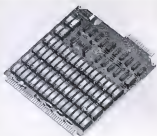
For further information, please contact Comex Systems, Inc., Executive Drive, Hudson, NH 03051. Telephone: 603-889-8564.

CIRCLE INQUIRY NO. 127

## Add-In Memory Products for HP's 21MX Computers

The NS-21 memory boards have a capacity of 16,000 words of 17 bits each, and are completely compatible with the HP system

models 2105, 2108, 2112 and 2113. They are used with a control card manufactured by National, or with the HP21 MX series control card.



One control card can communicate with up to twelve 16K NS21 storage cards, for a total storage capability of 192K words. The 16K version of the NS21 replaces two single density 8K cards, saving space and offering increased reliability.

The NS-21 features a savings of about 30 percent over the HP card.

The success of the NS-21, which uses 4K dynamic RAMs, has led to plans for other similar add-ins. This is only the first of a long line of add-in memories National will produce.

The NS-21 is also available in a depopulated 8K version. A single 8K card may be used with a 16K card system, or a maximum of sixteen 8K cards may be controlled together by one card, yielding up to 128K words of memory.

The 16K x 17 bit version of the NS21 memory storage card sells for \$995. Both versions are available for immediate delivery. For further information, contact National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, Calif. 95051, and from National's franchised distributors.

CIRCLE INQUIRY NO. 128

## 12-Digit VLED Display Board

A multi-digit visual light-emitting diode (VLED) display stick with 12 digits is said to be the largest number available on a single board in the industry today.



The TL804 characters are seven segment red VLEDs, .27 inch high and feature typical brightness of 500  $\mu$ cd at 20mA.

Features of the display stick include right hand decimals at each digit, continuous uniform brightness of segments within each digit and a wide viewing angle for distances up to 15 ft.

It is available now in common cathode configuration for ease in multiplex operation on rugged, one-piece printed circuit board construction.

Applications include Citizens Band radios, scanners, digital instrumentation, electronic games, medical electronics, test and measurement equipment and desk top calculators.

Prices are \$14.85 each in quantities up to 100 and \$11.65 each in quantities above 100 to 999. For further information, contact Texas Instruments Incorporated, Inquiry Answering Service, P.O. Box 5012, M/S 308 (Attn: TL804), Dallas, Texas 75222.

CIRCLE INQUIRY NO. 129

The Midwest's Most Complete Computer Store

## THE GENERAL COMPUTER STORE

- Compucolor
- Continental specialties
- Croemco
- D.E.C.
- Hitachi
- Iasis
- Imsai
- Intelligent systems

### WE STOCK

- Lear Siegler
- Microterm
- National Multiplex
- North Star
- Polymorphics
- Processor Tech.
- Sanyo
- SWTP
- Tarbell
- TDL
- Texas Instruments
- Vector Graphics
- Vector Electronics
- Vero-Tel
- Xytek
- Books and Magazines
- Sams - Hayden - Osborne
- Tab - etc. and many others.

ASK ABOUT OUR Z-80 SPECIAL  
SEND \$2 FOR OUR COMPLETE  
CATALOG OF PRODUCTS & PRICES.  
\*Refundable with purchase of \$25 or more.



The General Computer Company

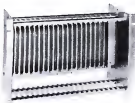
A computer company of professionals.

2011 LIVERNOIS • TROY, MICHIGAN 48064 • PHONE: (313) 382-0022

CIRCLE INQUIRY NO. 81

## ECT-100 Microcomputers

ECT-100 Microcomputers are engineered for use in dedicated control applications, turnkey systems or other Microcomputer systems applications.



The ECT-100 Card Cages are of rugged construction and fit the industry standard 19 inch cabinetry occupying seven RETMA increments (12.25 inches). They hold 20 printed circuit boards 10 x 5.3 on 1/4 inch centers which are removable from the front for easy accessibility. The bus structure is the standard 100 pin bus of the personal computers ("Altair" bus or S-100 bus). A wide variety of cards are available from more than 30 manufacturers: ECT-100 Card Cage; ECT-100-8080, A 8080 based Microcomputer; ECT-100-Z80, A Z80 based Microcomputer.

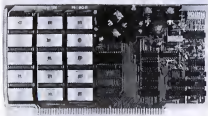
Prices start at \$100.

For further information contact Electronic Control Technology, P.O. Box 6 Union, New Jersey 07083.

CIRCLE INQUIRY NO. 130

## 8K Memory System

MOUNTAIN HARDWARE'S NEW PROM board is a S-100 compatible EPROM board with on-board programmer. The board has provisions for 7.5 Kilobytes of PROM and 512 bytes of RAM. The PROM used is the ultra-violet erasable AMI-S6834, which is a low cost 512 byte EPROM.



The on-board PROM programmer does not require any special software and can program from one byte, to all 7.5 Kbyte at a time. The on-board RAM provides memory for the often needed stack or other scratch pad area. The board is address selectable with dip switches, and a write protect switch saves programs from accidentally being changed. The unit comes with 256 words of RAM and one PROM, which is preprogrammed with a powerful 8080 system monitor. All components and sockets are included, along with a complete documentation package for \$164.00. For further information, contact Mountain Hardware, Box 1133, Ben Lomond, CA 95005; (408) 336-2495.

CIRCLE INQUIRY NO. 131

## Improved Hybrid Power Rectifier and Voltage Regulator

The Sanken Hybrid Power Rectifier and Voltage Regulator combination has 5 volt 2 amp. output and is designated SI-3050G. The module incorporates Bridge Circuit, Inside, Power Transistor and Flip Chip structure devices requiring few external components and no adjustments. SI-3050G also features over-load and short circuit protection.



Over all the SI-3050G provides excellent production cost economy and assembly simplicity. Priced at 1 up \$8.50, 25 up \$7.00, 50 up \$6.50 and 100 up \$6.10. Available from stock. For further information contact: Energy Electronic Products Corp., 6060 Manchester

Avenue, Los Angeles, California 90045, (213) 670-7880, TWX 910 328 8161 or 696397 (Telex)

CIRCLE INQUIRY NO. 132

## HOPE

The most beautiful word in the world  
... and a Project to go with it.

**PROJECT HOPE**

Dept. A, Washington, D. C. 20007

## Disc/3

## COMPUTER SUPERMART

TURNKEY SOFTWARE SPECIALISTS



## EASY TO ASSEMBLE

Lear-Siegler ADM-3 terminal kit with New DCA (direct cursor addressing) 24 lines x 80 characters; 64 ASCII upper characters, plus punctuation and control; 5 x 7 dot matrix; EIA standard RS232C and 20mA current-loop (switch selectable).

\$849.95\* with DCA

## FAST MICROPROCESSOR

IMSAI 8080 microcomputer, top of the line; rugged industrial quality; 28 amp power supply; 22 slot mother board; fully expandable to 64K; will support floppy disk drive, terminal, audio-tape cassette input device, 300 lpm printer.

\$659.95\*



Look to Disc/3... authorized distributors for IMSAI, Lear-Siegler, Cromemco, Z-80, Centronics Data Computer, Digital Equipment Corp., and Data General Corp. We also carry TDL.

## Disc/3

DISC/3 1840 Lincoln Blvd., Santa Monica, Calif. 90404  
Store hours — Monday-Friday 8:30-5:30 \*Prices subject to change.

## RUSH ORDER FORM — or Call Disc/3 (213) 451-8911

	KIT*	ASSEMBLED	TOTAL
ADM 3-K with DCA (24 x 80)	\$849.95	\$1099.95	
IMSAI 8080 microsystem	\$659.95	\$999.95	

Californians please add sales tax

Enclosed is my ☐ cashiers check, ☐ money order, ☐ personal check, ☐ \$100 deposit for C.O.D. Signature\_\_\_\_\_

☐ BankAmericard NO. \_\_\_\_\_ Expires \_\_\_\_\_  
☐ Master Charge NO. \_\_\_\_\_ Expires \_\_\_\_\_



NAME \_\_\_\_\_ ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_



CIRCLE INQUIRY NO. 79



# BYTE SHOP #32

the affordable computer store

"When you're #32  
You try a lot  
harder!"

Everything from **A** to **Z** available over the counter  
or by phone:

CALL: 1-803-771-7824

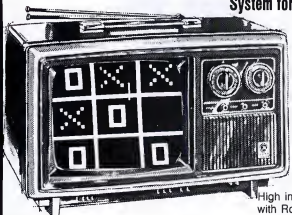
BANKAMERICARD and MASTER CHARGE WELCOME

STILL OFFERING:  
THE ONLY COMPLETE

## COLOR GRAPHICS

System for the S100 BUS!!

including:



10" DIAGONAL  
COLOR  
T.V.

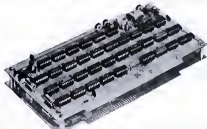
High impact plastic cabinet  
with Rosewood finish

and: the famous TV DAZZLER™ KIT by Cromemco

All for

**\$399.<sup>00</sup>**

**\$215.<sup>00</sup> without  
T.V.**



**Adds**

Apple II

Byt-8

Cromemco

Compucolor

Continental  
Specialties

DECwriters

Diablo

Digital Group

E & L

IMSAI

Lear-Siegler

Morrow

Mullen

National  
Multiplex

North Star

OK Wire Wrap

Oliver Audio

Polymorphic  
Systems

**Zilog**  
Weller  
Vector

Graphic

Unzar

TDL

Tarbell

Teletypes

Smoke Signal  
Broadcasting

Southwest  
Tech

Soroc

Shugart Mini-  
Floppy

Seals

S-D Sales

Processor  
Technology

# BYTE SHOP #32

the affordable computer store

2018 Green Street  
Columbia, SC 29205

South Carolina residents must add 4% sales tax.

TO ORDER

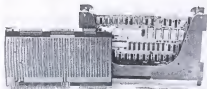
CALL NICK COLLECT

1-803-771-7824

1-803-648-9654 HOME

## Garry SBC 80/10 Universal Microprocessor Wire-Wrap Interface Board

SBC 80/10 Universal Microprocessor Interface Board, part number EP 272-38-15 is designed to plug directly into the Intel SBC 604 modular Cardcage/Backplane bus system with power interface connections for  $\pm 5$  and  $\pm 12$  VDC.



The Gary SBC 80/10 Universal Wire-Wrap board provides 38 columns of 44 low-profile socket terminals per column, with alternate rows of committed ground and voltage wire-wrap terminations. The P/N EP 272-38-15 interface board will accommodate up to 95 16-position I.C. chips or an equivalent mix of 14, 16, 18, 22, 24, 28 or 40-position I.C. chips.

For further information, contact: Garry Manufacturing Co., 1010 Jersey Avenue, New Brunswick, N.J. 08902; Telephone (201) 545-2424.

CIRCLE INQUIRY NO. 136

### OSI 470B Floppy Disc

The 470B is an upgrade of OSI's popular 470 floppy disc. The new disc features a GSI model 110 disc drive for 240K bytes single density storage or 480K bytes double density storage. The new disc also features a head load indicator and a prefabricated fifty line interconnecting cable. The introductory special for the 470B is \$599 for a fully assembled drive and cable harness, 6502 disc operating system, and controller board in kit form.



The drive is also available fully assembled for OSI Challengers including matching case and power supplies for \$990. OSI's floppy disc bootstrap prom allows the owner of any OSI system to use his floppy disc immediately on power up and is available for \$29 with either version of the 470B.

For further information, contact OSI, Ohio Scientific Instruments, 11679 Hayden Street, Heron, OH 44234.

CIRCLE INQUIRY NO. 137

### OSI 6502 8K BASIC

OSI's new 8K BASIC for the 6502 was written by Microsoft, the people who wrote ALTAIR® 8K BASIC for the 8080. OSI's 6502 8K BASIC is identical to this powerful and popular 8K BASIC with two very important exceptions: our OSI 6502 8K BASIC has automatic string space handling, and it runs faster. Up to 8 times faster than the 8080 BASIC. And hundreds of times faster than many 6800 BASICs.

In fact, the OSI Challenger with OSI 6502 8K BASIC can actually outperform most small and medium-scale minicomputers, as well as

every micro there is! And that includes the Z-80.

Perhaps even more amazing than its superlative performance is its surprisingly low price: either \$50 or free.

OSI 6502 8K BASIC is available to OSI System kit builders for \$50, on your choice of paper tape, audio cassette or floppy disc.

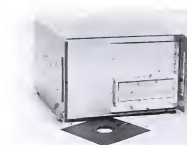
And OSI 6502 8K BASIC comes free with the purchase of any 12K or larger OSI Challenger.

For further information, contact OSI, Ohio Instruments, 11679 Hayden Street, Hiram, OH 44234.

CIRCLE INQUIRY NO. 138

### Microprocessor Floppy Disc System

A complete floppy disc system for the 6800 microprocessor, housed in a ruggedized, medium blue aluminum cabinet, the Micro-68 floppy disc system comes complete with single or dual disc drive, drive electronics, controller and exorcisor compatible interface for the 6800.



Each IBM compatible disc will hold 1/4 million words of information. Price complete with power supplies is \$2595 for the single drive system and \$3295 for the dual drive system. Floppy disc operating system, assembler and editor are included. Delivery is 2 weeks.

For further information, contact EPA Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 139

# DON'T FEEL ABANDONED

We offer system prices on:

IMSAI  
NORTH STAR  
POLYMORPHIC SYSTEMS  
NATIONAL MULTIPLEX  
SOLID STATE MUSIC  
LEAR-SIEGLER  
VECTOR GRAPHIC  
SEALS  
TARBELL  
MICROTERM  
OKIDATA  
SOROC  
ICOM  
TDL



★ QUALITY MERCHANDISE  
★ AT DISCOUNT PRICES  
★ FAST LOW COST DELIVERY  
★ FACTORY GUARANTEED

## BYTE SHOP MAIL ORDER

P.O. BOX 28106  
TEMPE, ARIZONA 85282  
602 - 894-1129

Name \_\_\_\_\_  
Phone (\_\_\_\_) \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

VISIT OUR RETAIL BYTE SHOPS:

813 N. Scottsdale Rd. 12654 N. 28th Drive  
Tempe, Az. 85281 Phoenix, Az. 85029  
(602) 894-1129 (602) 942-7300

Quote me your Discount Price on the Following System Package:

COMPUTER \_\_\_\_\_  
OPTIONS \_\_\_\_\_  
MEMORIES \_\_\_\_\_  
DISPLAYS \_\_\_\_\_  
OTHERS \_\_\_\_\_

☐ Kit ☐ Assembled

2612 E. Broadway  
Tucson, Az. 85716  
(602) 327-4579



SEND \$2.00 FOR OUR 40 PAGE COMPREHENSIVE CATALOG

## Low-Cost SC/MIP Microprocessor Board Family Gives Multiprocessing Capability

A new family of compatible microprocessor cpu and memory application cards, from the Microcomputer Systems Group of National Semiconductor Corporation, combines the features of on-card memory, small size, and low price with the capability of page addressing, multiprocessing and direct memory addressing (DMA) to give an off-the-shelf microcomputer for physically confined situations. Based on the 8-bit, single-chip SC/MIP microprocessor, the cards reduce development time in applications ranging from games to industrial controls.

The basic cpu card is the ISP-8C/100 application module with SC/MIP microprocessor, timing & control circuits, 256 B of random access memory (RAM), a socket for either 512 bytes of programmable-read-only memory (PROM), or 512 bytes of pin-compatible read-only memory (ROM), and complete buffer

circuits. Measuring only 4.375 inches by 4.862 inches, the card has an 8-bit Tri-State<sup>®</sup> data/control bus and a latched 16-bit address bus. The expanded address bussing permits selecting up to 16 memory pages as well as specific locations within the page. Built-in data bus and address allocation logic facilitates multiprocessor and DMA applications.

The ISP8C/100 card has two separate ports which allow input and output of RS-232-type serial data. Three program-controlled flag output signals and two program-controlled sense inputs allow convenient single-line peripheral control.

The SC/MIP has a 46-word instruction repertoire, including both single-byte and double-byte commands. For memory-efficient programming, the processor has five memory and peripheral addressing modes. Four 16-bit address-pointer registers reduce address formation overhead and allow subroutine nesting. The chip design permits static operation with no refresh required.

The ISP-8C/100 SC/MIP cpu card is priced at \$250 each in quantities to 24; \$238 each in quantities above 25. The ISP-8C/002 RAM card is priced at \$160 each in 1-24 quantities; \$152 each above 25. The ISP-8C/004P card, with 4K of memory supplied, is \$525 each in 1-24 quantities; \$499 each above 25. The ISP-8C/004B ROM/PROM socket card is \$125 each in 1-24 quantities; \$119 each above 25. Delivery is stock to 15 days.

For further information, contact National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 140

## NMOS Microcomputer Kit—An Educator II

Motorola's HEP/MRO Operations group, introduced an 8-bit microcomputer system in kit form, is called the Educator II. The kit contains an NMOS 8-bit MPU, PIA, 128x8-bit static RAM; two TTL 512x4-bit ROMs and a TTL clock circuit. The NMOS components are the HEP versions of the popular M6800 microcomputer products. Educator II utilizes the full instruction set and address modes of the MC6800 MPU. The clock frequency is approximately 624 KHz.



An executive program, residing in the ROMs, contains routines for examining and modifying memory locations and MPU registers, servicing interrupts, transferring programs to and from cassette tapes, searching tapes for specific programs and a routine to test the finished kit. The executive uses 14 bytes of RAM for a scratchpad; the remaining 114 bytes are for user programs. An optional 128x8-bit RAM can be added to the p.c. board for larger user programs.

Educator II is housed in a sturdy aluminum case. Front panel toggle switches and LEDs are used to enter and display machine code. Edge connectors on the p.c. board provide an interface to the PIA and address, data and control busses for system expansion. Educator II accessories, planned for the near future include a keyboard kit, video display kit, a module card rack and power supply, memory modules and applications programs on cassettes.

P.O. Box 4430N Santa Clara, CA 95054  
(408) 988-1640

## ELECTRONICS

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

### INTEGRATED CIRCUITS

MODEL	MANUFACTURER	DESCRIPTION	PRICE
7400	TI	NOTES 5. 6. 9. 10.	1.00
7401	TI	NOTES 5. 6. 9. 10.	1.00
7402	TI	NOTES 5. 6. 9. 10.	1.00
7403	TI	NOTES 5. 6. 9. 10.	1.00
7404	TI	NOTES 5. 6. 9. 10.	1.00
7405	TI	NOTES 5. 6. 9. 10.	1.00
7406	TI	NOTES 5. 6. 9. 10.	1.00
7407	TI	NOTES 5. 6. 9. 10.	1.00
7408	TI	NOTES 5. 6. 9. 10.	1.00
7409	TI	NOTES 5. 6. 9. 10.	1.00
7410	TI	NOTES 5. 6. 9. 10.	1.00
7411	TI	NOTES 5. 6. 9. 10.	1.00
7412	TI	NOTES 5. 6. 9. 10.	1.00
7413	TI	NOTES 5. 6. 9. 10.	1.00
7414	TI	NOTES 5. 6. 9. 10.	1.00
7415	TI	NOTES 5. 6. 9. 10.	1.00
7416	TI	NOTES 5. 6. 9. 10.	1.00
7417	TI	NOTES 5. 6. 9. 10.	1.00
7418	TI	NOTES 5. 6. 9. 10.	1.00
7419	TI	NOTES 5. 6. 9. 10.	1.00
7420	TI	NOTES 5. 6. 9. 10.	1.00
7421	TI	NOTES 5. 6. 9. 10.	1.00
7422	TI	NOTES 5. 6. 9. 10.	1.00
7423	TI	NOTES 5. 6. 9. 10.	1.00
7424	TI	NOTES 5. 6. 9. 10.	1.00
7425	TI	NOTES 5. 6. 9. 10.	1.00
7426	TI	NOTES 5. 6. 9. 10.	1.00
7427	TI	NOTES 5. 6. 9. 10.	1.00
7428	TI	NOTES 5. 6. 9. 10.	1.00
7429	TI	NOTES 5. 6. 9. 10.	1.00
7430	TI	NOTES 5. 6. 9. 10.	1.00
7431	TI	NOTES 5. 6. 9. 10.	1.00
7432	TI	NOTES 5. 6. 9. 10.	1.00
7433	TI	NOTES 5. 6. 9. 10.	1.00
7434	TI	NOTES 5. 6. 9. 10.	1.00
7435	TI	NOTES 5. 6. 9. 10.	1.00
7436	TI	NOTES 5. 6. 9. 10.	1.00
7437	TI	NOTES 5. 6. 9. 10.	1.00
7438	TI	NOTES 5. 6. 9. 10.	1.00
7439	TI	NOTES 5. 6. 9. 10.	1.00
7440	TI	NOTES 5. 6. 9. 10.	1.00
7441	TI	NOTES 5. 6. 9. 10.	1.00
7442	TI	NOTES 5. 6. 9. 10.	1.00
7443	TI	NOTES 5. 6. 9. 10.	1.00
7444	TI	NOTES 5. 6. 9. 10.	1.00
7445	TI	NOTES 5. 6. 9. 10.	1.00
7446	TI	NOTES 5. 6. 9. 10.	1.00
7447	TI	NOTES 5. 6. 9. 10.	1.00
7448	TI	NOTES 5. 6. 9. 10.	1.00
7449	TI	NOTES 5. 6. 9. 10.	1.00
7450	TI	NOTES 5. 6. 9. 10.	1.00
7451	TI	NOTES 5. 6. 9. 10.	1.00
7452	TI	NOTES 5. 6. 9. 10.	1.00
7453	TI	NOTES 5. 6. 9. 10.	1.00
7454	TI	NOTES 5. 6. 9. 10.	1.00
7455	TI	NOTES 5. 6. 9. 10.	1.00
7456	TI	NOTES 5. 6. 9. 10.	1.00
7457	TI	NOTES 5. 6. 9. 10.	1.00
7458	TI	NOTES 5. 6. 9. 10.	1.00
7459	TI	NOTES 5. 6. 9. 10.	1.00
7460	TI	NOTES 5. 6. 9. 10.	1.00
7461	TI	NOTES 5. 6. 9. 10.	1.00
7462	TI	NOTES 5. 6. 9. 10.	1.00
7463	TI	NOTES 5. 6. 9. 10.	1.00
7464	TI	NOTES 5. 6. 9. 10.	1.00
7465	TI	NOTES 5. 6. 9. 10.	1.00
7466	TI	NOTES 5. 6. 9. 10.	1.00
7467	TI	NOTES 5. 6. 9. 10.	1.00
7468	TI	NOTES 5. 6. 9. 10.	1.00
7469	TI	NOTES 5. 6. 9. 10.	1.00
7470	TI	NOTES 5. 6. 9. 10.	1.00
7471	TI	NOTES 5. 6. 9. 10.	1.00
7472	TI	NOTES 5. 6. 9. 10.	1.00
7473	TI	NOTES 5. 6. 9. 10.	1.00
7474	TI	NOTES 5. 6. 9. 10.	1.00
7475	TI	NOTES 5. 6. 9. 10.	1.00
7476	TI	NOTES 5. 6. 9. 10.	1.00
7477	TI	NOTES 5. 6. 9. 10.	1.00
7478	TI	NOTES 5. 6. 9. 10.	1.00
7479	TI	NOTES 5. 6. 9. 10.	1.00
7480	TI	NOTES 5. 6. 9. 10.	1.00
7481	TI	NOTES 5. 6. 9. 10.	1.00
7482	TI	NOTES 5. 6. 9. 10.	1.00
7483	TI	NOTES 5. 6. 9. 10.	1.00
7484	TI	NOTES 5. 6. 9. 10.	1.00
7485	TI	NOTES 5. 6. 9. 10.	1.00
7486	TI	NOTES 5. 6. 9. 10.	1.00
7487	TI	NOTES 5. 6. 9. 10.	1.00
7488	TI	NOTES 5. 6. 9. 10.	1.00
7489	TI	NOTES 5. 6. 9. 10.	1.00
7490	TI	NOTES 5. 6. 9. 10.	1.00
7491	TI	NOTES 5. 6. 9. 10.	1.00
7492	TI	NOTES 5. 6. 9. 10.	1.00
7493	TI	NOTES 5. 6. 9. 10.	1.00
7494	TI	NOTES 5. 6. 9. 10.	1.00
7495	TI	NOTES 5. 6. 9. 10.	1.00
7496	TI	NOTES 5. 6. 9. 10.	1.00
7497	TI	NOTES 5. 6. 9. 10.	1.00
7498	TI	NOTES 5. 6. 9. 10.	1.00
7499	TI	NOTES 5. 6. 9. 10.	1.00
7500	TI	NOTES 5. 6. 9. 10.	1.00

**Not a Cheap Clock Kit \$17.45**  
Includes everything, except a 555 timer. PC boards, 6-50' LED Displays. 5314 clock chip, transformer, all components and full instructions. Same clock kit with 80' displays. **\$22.75**

**Digital Temperature Meter Kit**  
Indoor and outdoor. Automatically switches back and forth. Beautiful 50' LED readings. Nothing like it available. Needs no additional parts for complete full operation. Will measure -100° to +200°F, air or liquid. Very accurate. Complete instructions. **\$59.95**

**8080A Microcomputer Kit**  
8080A CPU, Crystal Clock, I/O Buffers, RAM and PROM. D/A—A/D converter. PROM Programmer. Memory expander. Complete documentation incl. assembly instructions, programming etc. **\$195.00**

**1977 IC Update Master**  
Manual Brand new. Complete integrated circuit data selector from all manufacturers. 1254 page master rd. equivalent to the latest IC's including microprocessors and consumer circuits. 17,000 cross references for easier sourcing of hard to get parts. \$38.00 with free update service thru 1977. Domestic postage add \$2.00. Foreign \$5.00.

**Frequency Counter Kit**  
Continuous, ultrasonic and low amateur band 10 Hz to 2.5 MHz typ. Dual channel high sensitivity -25 millivolts. Crystal controlled clock. Can be preset for higher frequency. 6-50' digits. Full instructions. Less power supply. **\$40.00**

**30 MHz Frequency Counter Kit**  
Crystal time base. Covers auto, amateur and CB band. 6-5' digits, presettable with PC board and full instructions. **\$55.00**  
Fully wired and tested. **\$75.00**  
Add \$10.00 for beautiful pintrigless case.

**Stopwatch Kit \$26.95**  
Full six digit battery operated, 2-5 volts. 2.768 MHz crystal accuracy. Times 59 minutes, 59 seconds, 99/100 hrs. Times standard, split and timer. 7205 chip, all components minus case. Full instrud.

**COSMAC 'ELF'**  
RCA COSMAC Microprocessor  
COSMAC II \$29.50. User Manual \$7.50  
Complete kit of parts to build the "ELF" including COSMAC and users manual as listed in August '76 P.P. Elect. items power supply and board. **\$92.00**

**60 Hz Crystal Time Base Kit \$4.75**  
Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

**VOLUME SPECIALS**  
MM5369 2x RAM 1.00  
MM5369 2x RAM 1.00  
2101-1 500 KHz RAM 1.00  
2101-1 500 KHz RAM 1.00  
Microscopy Photomicrograph 50.00

**Portable Clock Timer Kit \$19.95**  
50' clock module, crystal time base. Oscillator from 50 battery. Complete with case and instructions. Excellent for airplane, dashboard, car etc.

**Stopwatch/Timer Kit \$55.00**  
4 digit, 7 function precision stopwatch/timer. Two PC boards, components and case. Crystal controlled, this kit is excellent for rally and overland use as navigational, photography and for application control.

**Auto Clock Kit \$15.95**  
DC clock with 4-50' displays. Uses National MA1012 module with alarm option. Crystal time base PC boards and full instructions. Add \$2.95 for a beautiful dark gray case ready to install. This is the best value available anywhere!

TERMS: \$5.00 min. order U.S. Funds. Calif. residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added.

FREE: Send for your copy of our 1977 QUEST CATALOG. Include 13¢ stamp.

CIRCLE INQUIRY NO. 97

The p.c. board layout is quite simple; kit construction could be accomplished in one evening. All components necessary to get the microcomputer "up and running" are supplied, even the solder. A separate power supply, of course, is required. A Test-As-You-Build feature provides for accurate, minimum error construction.

A comprehensive construction/instruction manual is included with the kit. Nothing is left to chance in the manual, construction steps are explicitly detailed. Theory of operation of the kit's NMOS microcomputer components are described in an articulate manner. The user is "stepped through" increasingly complex demonstration programs, shown the basics of debugging and how to use the cassette operation. Applications programs are described and listed, along with a listing of the resident firmware.

Educator II retails for \$169.95 and is available from selected Motorola HEP and MRO distributors and other distributors, nationally. The additional 128x8-bit RAM is also available at the same locations; the retail price is \$19.04.

For further information contact: Motorola HEP/MRO National Sales Manager, 705 West 22nd Street, Tempe, Arizona 85282; (602) 244-3208, or the Technical Information Center, Motorola Semiconductor Products, Inc., P.O. Box 20924, Phoenix, Arizona 85036.

CIRCLE INQUIRY NO. 141

### Colorful Enclosures Permit Convenient Card, Module and Component Mounting

A line of enclosures, called VECTOR-PAK, features panels with clear- or black-anodized aluminum finish or with mar-resistant textured vinyl covers in ten standard colors: walnut-grain wood, dark blue, sky blue, orange, avocado, grey, beige, white and black. The bezel and trim extrusions have clear-anodized or black-anodized finish.



The units find applications in laboratory equipment, instruments, computers, peripheral controllers, and development systems. A variety of optional card guides, brackets and straps permit convenient installation of cards, modules, electronic components or electro-mechanical assemblies from the front, top or rear with either horizontal or vertical orientation.

The internal structure consists of 0.080 inch thick aluminum sidewalls joined by four multipurpose struts. Available in 17 sizes, the sidewalls have repeating patterns of 1.2 inch by 0.15 inch vertically-slotted holes on 0.75 inch centers. The struts are attached directly or with horizontally-slotted brackets to allow precise adjustment of case dimensions. Outside dimensions range from 3.76 inches to 10.75 inches in height, 10.4 inches to 21.5 inches in depth and 8.65 inches to 17.5 inches in width.

The enclosures may be purchased with or without the interior structure either fully assembled or in easily assembled kits. Without internal mounting structures single-unit VECTOR-PAK enclosure prices range from \$65.00 to \$95.00; with internal structure the prices range from \$125.00 to \$185.00. Custom unit prices on request. Delivery is stock to four weeks ARO.

For further information, contact Vector Electronic Company, 12460 Gladstone Avenue, Sylmar, CA 91342; (213) 365-9661; TWX (910) 496-1539.

CIRCLE INQUIRY NO. 142

### Analog I/O System for Intel SBC80

Burr-Brown's new MP8600 Analog I/O System is the first 8-bit plug-compatible system offered for Intel's SBC80, and the best priced analog I/O available for that microcomputer. It is the first system of its kind available at a price substantially below that of the computer with which it operates.



A single board contains the analog input and output, and is electrically and mechanically plug-compatible with both the SBC80 and the Intel<sup>®</sup> MD8.

Each board can accommodate up to 64 single-ended or 32 differential input channels and two output channels. A high-gain instrumentation amplifier handles input levels as low as 10mV FS allowing direct connection to low-level inputs such as thermocouples.

To simplify software implementation, the MP8600 interfaces to the SBC80 as memory. Each analog input or output channel occupies one memory location. Any memory instruction can be used to access data. Thus, one LDA instruction will input data from one channel to the accumulator. Two adjacent input channels can even be acquired with one LHLDA instruction.

The analog input portion of the MP8600 includes an analog multiplexer, high-gain instrumentation amplifier, 8-bit A/D converter, plus necessary timing, decoding and control logic. The analog output portion consists of two 8-bit D/A converters with input latches and control logic. A D/C converter is available for operation from the computer's +5VDC power supply.

Input and output specifications include: input voltage range of  $\pm 10\text{mV}$  to  $\pm 5\text{V}$ , input overvoltage protection of  $\pm 15\text{V}$ , and input throughput accuracy better than 0.4% FSR on  $\pm 5\text{V}$  range. Output voltage range is strap selectable with five ranges to  $\pm 10\text{V}$  at 5mA. Output throughput accuracy is better than  $\pm 0.4\%$ .

A basic input-only board with eight channels differential or 16 channels single-ended is priced at \$295 (1-9) and \$198 (100's). A fully loaded board with 32 channels differential or 64 channels single-ended plus two output channels and D/C converter is priced at \$685 (1-9) and \$407 (100's). Delivery for small quantities is two weeks.

For more information, contact Burr-Brown, International Airport Industrial Park, Tucson, Arizona 85734. Phone (602) 294-1431.

CIRCLE INQUIRY NO. 143

# NOW TRY US!

The word is getting around... the Byte Shop of Pasadena is a remarkable exception to the rule among computer stores. We offer a truly delightful environment supported by

- \* REAL courtesy
- \* REAL expertise
- \* EXPERT service
- \* GREAT classes

\* up to EIGHT demo systems and of course, a wide variety of low-priced computer hardware, software, tools and supplies. Come see what the happy rumors are all about... then compare our store with ANY other!

THE AFFORDABLE  
**BYTE  
SHOP**  
COMPUTER STORE

The BYTE SHOP of Pasadena  
496 South Lake Avenue  
Pasadena, California 91101  
Telephone: (213) 684-3311

— HOURS —

Tuesday-Saturday: 12-9  
Sunday: 12-5  
Monday: closed



BankAmericard Mastercharge  
American Express

CIRCLE INQUIRY NO. 66



## Book Review

### SOFTWARE DESIGN FOR MICROPROCESSORS

John G. Webster  
and William D. Simpson  
Texas Instruments Inc., 1976.

About 400 pages \$12.95.

Review by  
Judy Scolney Robertson &  
Larry Robertson

*Software Design For Microprocessors* "was written to assist technical and non-technical people in taking their first steps toward designing with microprocessors and related software. Topics range from the basics of binary numbers to complex examples of microprocessor applications." Although the authors claim the book was written for those with little or no programming experience, the novice reader had best be an electrical engineer with a fair amount of exposure to digital systems.

Software is presented on the machine language level or at best in assembler code. Only cursory mention is made of the possibility of using higher level languages and subroutine libraries. From the programming standpoint, the book views the processor so narrowly that the authors do not even begin to utilize the power of the computer.

*Software Design* is a text developed for use in conjunction with the Texas Instruments Microprocessor Learning Module. The book by itself, however, is adequate for the electrical engineer who wishes to utilize microprocessors to replace logic gates and for the highly experienced programmer who desires to use

microprocessors for "nitty-gritty" applications. The person who is totally unfamiliar with electronics will flounder a while and rapidly drown in the mire of logic gate and driver descriptions.

The authors have paid extreme attention to detail in their descriptions. Most of these descriptions pertain specifically to the Texas Instruments product line. Examples all refer to special purpose applications of TI equipment, for example an electronic taxi meter and a badge reading system.

About half the book is appendices, including an excellent glossary. One hundred and twenty-nine pages (a full one third of this book) comprise a detailed collection of data sheet descriptions of TI microprocessors. Of the many conversion tables (mostly of the standard variety), by far the most amusing is the list of Common Mathematical Constants which provides values to fifteen places decimal (eight places hexadecimal) of such constants as  $e$  (2.718281828) and  $\pi$  (3.141592653), as well as reciprocals and square roots of these and other commonly used items.

*Software Design For Microprocessors* is by no means a basic text, but the electrical engineer or experienced programmer with some knowledge of logic circuits may find it a helpful reference for special purpose microprocessor applications.

*Software Design For Microprocessors* is available through Texas Instruments, Inc., P.O. Box 3640, M/S-84, Dallas, TX 75285.

### THE UNDERGROUND BUYING GUIDE FOR HAMS, CBERS, EXPERIMENTERS AND COMPUTER HOBBYISTS

Dennis A. King  
PMS Publishing Company, 1977.  
185 pages. Paperback \$5.95

Review by  
Judy Scolney Robertson &  
Larry Robertson

The orientation of *The Underground Buying Guide* is best expressed in the author's dedication:

This book is dedicated to:  
Electronic hobbyists world wide who believe that building is better than buying, that experimenting and week-end dabbling is the best instructor that any-

one ever had and that the greatest satisfaction that can come from a hobby is building something that works from scratch.

Dennis King has compiled, out of his own experience, a handy listing of electronics parts, services and vendors arranged in three easily referenced lists. Part One of the book is an alphabetical index of firms described in detail with addresses and telephone numbers. There is enough information about each supplier that the hobbyist can order any component he may need based on the data provided in this book. *The Guide* lists which firms discount prices, which give free catalogs and other literature, which have toll-free numbers (the numbers are provided) and which accept credit cards, and if so, lists the cards accepted. Some prices and price ranges are also given, as is a sampling of products and services offered by each supplier. In addition to the alphabetical listing, firms are also sorted and listed by state (section two) and references are given to the detailed descriptive data in the alphabetical section.

Parts and services are listed alphabetically in section two of *The Guide*. No details are provided for any of the items listed, but a rather complete selection of suppliers is provided along with referrals to page numbers in the alphabetical listing.

*The Underground Buying Guide* is exactly what the title suggests — a buying guide designed for the electronics hobbyist. The user may find exactly what he needs at a lower price. The listing includes small firms and mail order houses, often with discount prices. We find *The Guide* to be extremely useful and applaud King's efforts to compile and share the results of his experiences in acquiring equipment for hams, CBers, experimenters, and last, but by no means least, home computer owners and builders.

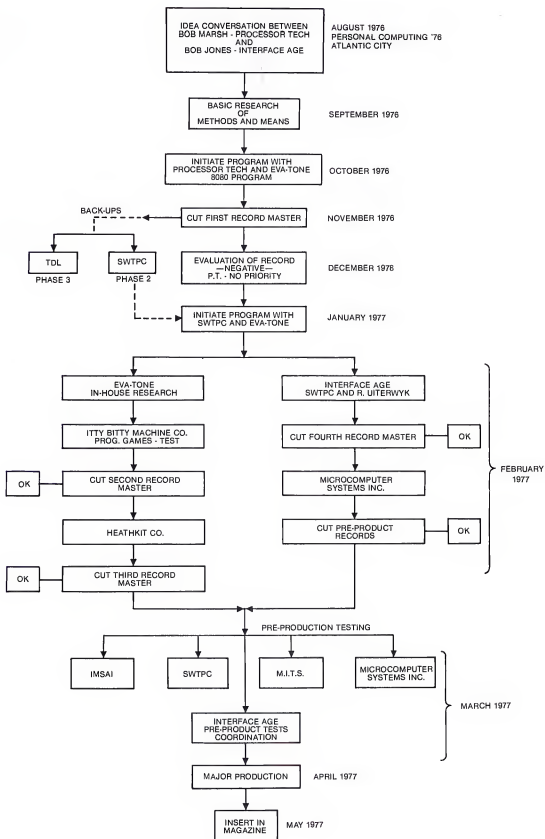
*The Guide* is so new it has not appeared in any stores yet. It is available by mail from Peninsula Marketing Services, 12625 Lido Way, Saratoga, CA 95079. Add 50 cents for postage and handling. California residents add 39 cents sales tax.

Next month the Robertsons will review *Techniques of Program Structure and Design* by Edward Yourdon, Prentice-Hall 1975.

*The Shoestring, Start-at-Home, Computer Business Handbook: 21 Ventures from the Garage, Basement, Bedroom or Closet for the Aspiring Computrepreneur* by George Alan, Datasearch, Inc. 1977.



### MILESTONE CHART





# HARDWARE

by Roger Edelson  
Hardware Editor

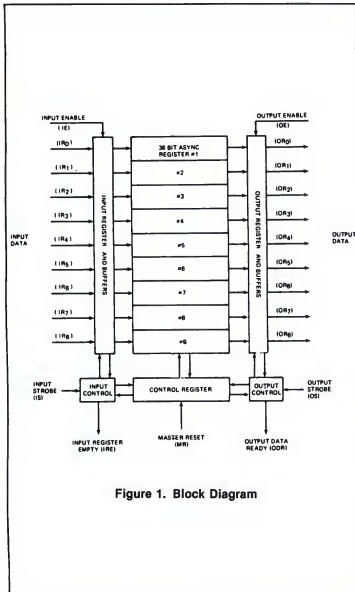


Figure 1. Block Diagram

This month the Hardware Report will cover an IC which is a very useful device for interfacing between your computer and other devices with a high data flow. The chip is Western Digital's MOS/LSI FR1502E First-In/First-Out Buffer Register. This device is more commonly referred to as a FIFO. The advantage of a FIFO is that it can provide SILO/ELASTIC storage to buffer asynchronous data inputs to a synchronous computer interface. The FR1502E FIFO is an asynchronous memory organized in a 9-bit by forty character stack. Characters are loaded onto the top of the stack and then "sink" to the bottom of the stack or are halted just above the level of previously entered data. All this takes place without the need for the application of external clocking signals. As a character is removed from the bottom of the stack, all of the previously loaded data will drop one character nearer to the output.

FR1502E FIFO Features include:

- 1 SILO/ELASTIC STORAGE
- 2 40 CHARACTERS BY 9 BITS
- 3 EXPANDABLE CHARACTER AND BIT SIZE WITH NO EXTERNAL COMPONENTS
- 4 MAXIMUM ASYNCHRONOUS I/O ACCESS (Subgroups available in dc to 550 KHz and DC to 250 KHz)
- 5 INPUT/OUTPUT READY STATUS FLAGS
- 6 THREE-STATE I/O WITH SEPARATE ENABLES
- 7 DIRECTLY TTL AND DTL COMPATIBLE
- 8 MASTER RESET
- 9 28-PIN DIP PACKAGE

Applications for this FIFO include data transmission buffers, auto dialers, key-to-tape or key-to-disc equipment, CRT buffer memory, and any place an asynchronous to synchronous (or asynchronous) buffer is required.

The FR 1502E FIFO provides signals for handshaking to insure data exchange without error. Data can be entered whenever the IRE (Input Register Empty) line is high. Data is loaded by strobing the IS (Input Strobe) line high while the IE (Input Enable) line is also high. The positive going edge of the IS resets IRE and the negative going edge enables the data to begin rippling through the FIFO. As soon as this data has left the input register, IRE will again go high and additional data can be loaded. When data reaches the FIFO, the ODR (Output Data Ready) line will go high. A low level pulse on the OS (Output Strobe) line will shift this data out of the FIFO, if the OE (Output Enable) line is also high. The FIFO data outputs are floating whenever the OE line is low. The negative going edge of the OS pulse resets ODR and causes data in the FIFO to ripple towards the output.

The logic conventions of the handshaking signals and the internal delays of the FIFO have been chosen to allow direct expansion of the buffer memory without external hardware.

# REPORT

Figure 1 provides a block diagram of the FIFO. It can be seen that the chip is arranged as a series of three registers (a 1-bit input, a 38-bit asynchronous and a 1-bit output register). Control is divided into input, register, and output control. The input control provides the IRE signal and responds to the IS line. The output control provides the ODR signal and responds to the OS line. IE and OE signals enter the Input and Output registers respectively.

Let's take a look at the individual signals themselves:

**IR0-IR8** These are the nine input data lines. Data on these nine lines are parallel loaded into the FIFO when the IS is high and the IE is also high. Loading will not occur unless the first stage is empty as signaled by a high IRE. These inputs are TTL compatible and are tri-state — that is, when the IE goes low, the internal resistor pull-ups are disconnected resulting in a floating input.

**IRE** (Input Register Empty) When the IRE line is high data may be loaded into the first stage. IRE is reset to a low by the positive going edge of the input pulse.

**IS** (Input Strobe) Data on the IRD lines is loaded into the first stage of the FIFO when this line is high, if the IE line is also high. On the negative going edge of IS the loaded data begins shifting towards the FIFO output. When the IE line is low the IS line is floating.

**MR** (Master Reset) This input when strobed high, clears the FIFO control register, sets IRE high, sets ODR low, and leaves the bit registers including the output register data (ORO-OR8) lines at an unspecified state. This is particularly important to remember — the bit registers are not cleared by the MR line.

**ORO-OR8** (Output Register Data) The output data lines present the previously loaded data in a first-in/first-out manner after it has fallen to the output stage. The data lines are only valid when the OE is high. The outputs are floating when the OE is low.

**OS** (Output Strobe) The negative going edge of this signal resets the ODR line and then shifts the data in the FIFO if the OE line is high. The positive going edge of this signal can occur before the data ready condition occurs.

**ODR** (Output Data Ready) When valid data is available at the data output lines the ODR signal will go high. The ODR is reset to a low condition by

the negative going edge of the OS, if the OE is high.

**IE** (Input Enable) This line controls the tri-state condition and the control of the input register and control. The line must be high before the FIFO will respond to IS Pulses. The IRD lines are floating when this line is low.

**OE** (Output Enable) This line must be high before the ORD lines will respond to the logical output levels of the previously loaded data. When the OE line is low the ORD lines are floating.

The chip requires +5 volts ( $\pm 5\%$ ) for  $V_{SS}$  and -12 volts ( $\pm 5\%$ ) for VGG.

Figures 2 and 3 indicate, respectively, the Input and Output timing characteristics of the chip. Note that in both cases the chip will not respond unless the appropriate ENABLE line is high. When the lines are low the state of the chip cannot be changed but the previously stored data will not be lost.

Let us take a look at the Input timing. When the IRE line is high the FIFO is ready to accept another nine bits of data. At this point the positive going edge of the input strobe resets the IRE line to insure that no more data will attempt to be loaded until the present data has been processed. The IS signal cannot go high until 350 ns. after IE has been brought high. The data must be stable within 150ns after IS has gone high.

In most cases it is easier to set up the data before strobing the IS line. However, if the two events are simultaneous, make sure that there is no more than 150ns delay in the data lines. The IS signal must remain high for at least 175ns. After the IS signal has gone low the data must remain stable for at least an additional 75ns. If the data does not remain valid for this period, unreliable operation will result. I found it very convenient to have the data valid bracket the IS signal.

When the IS signal goes low the data begins to be transferred from the Input Register to the 38-bit asynchronous register. As soon as the Input Register is free to accept more data, the IRE line will go high. This can take a maximum of 825ns. before the Input register will again be empty after the IS signal goes low. The logic design should either insure that no new data is presented prior to 75ns. after IS goes low and sufficient time is allowed to process the data before expecting the chip to accept new data. The alternative technique would be to allow the rising edge of IRE to clock the new data to the FIFO.

The Output timing follows the same general pattern as the Input timing. A high ODR signal indicates that a character is available at the output lines. After the using

## SWITCHING CHARACTERISTIC

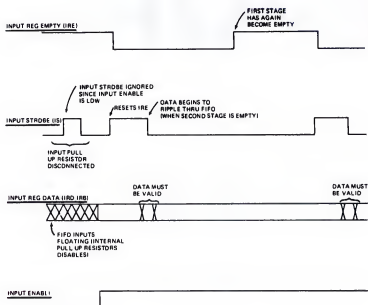


Figure 2. Input Timing

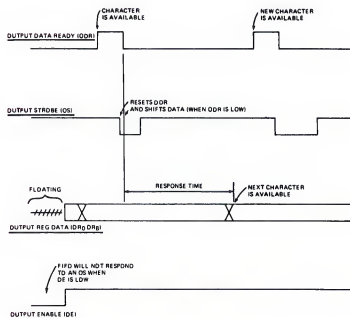


Figure 3. Output Timing

# INTRODUCING THE ULTIMATE IC SOURCE BOOK THE NEW 1977 IC MASTER

## THE FORMAT OUTLINED:

- **FIVE MASTER SELECTION GUIDES** — 84 companies' IC's organized by type, function, key parameters
- **OVER 1,000 PAGES OF TECHNICAL INFORMATION** — Provided directly by manufacturers covering 17,000 IC's
- **ALTERNATE SOURCE DIRECTORY** — The only industry-wide, pin-for-pin version available
- **MILITARY PARTS INDEX AND CROSS REFERENCE CHART** — Identifies all IC's with JAN qualification
- **MILITARY DEVICE TESTING TABLE** — List companies that screen to Mil. Std. 883
- **MILITARY PARTS INDEX** — The first functional guide to JAN qualified parts
- **PART NUMBER INDEX** — Parts from 84 manufacturers, in numerical sequence
- **APPLICATION NOTE DIRECTORY** — Digest of currently active application note material
- **PRODUCT INDEX** — Provides alphanumeric listing of 84 manufacturers' lines
- **PART NUMBER GUIDE** — Instantly decodes each company's part numbering system
- **MANUFACTURERS AND DISTRIBUTORS DIRECTORY**



Virtually every IC device manufactured in the United States is listed in the 1977 IC MASTER. The format has been improved, simplified and made even more complete.

The IC MASTER is the easy and sensible means of narrowing down your IC choices quickly, accurately and systematically. All information is cross-referenced and indexed for rapid problem solving and device selection. And, additionally, the MASTER is updated three times yearly by accumulative supplements.

The 1977 IC MASTER is unique. It is the only compendium of its kind in existence at this time. Others may follow, but why wait? Your IC problems won't!

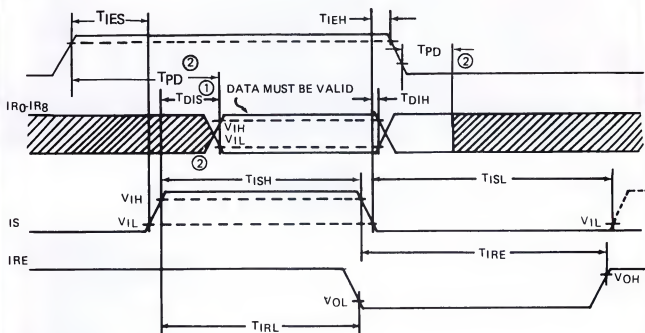
Mail Coupon To:  
IC MASTER  
645 Stewart Ave.  
Garden City, NY 11530

Att: Patti Foley

**IC MASTER, '77** Yes, please rush me a copy today!  
Enclosed is my check or money order for \$39.50 (plus sales tax: CA 6 1/2%; NY 8%).

Name .....  
Company .....  
Address .....  
City .....  
State .....  
Zip .....

### INPUT DETAIL



**Figure 4.**

The timing diagram illustrates the relationship between the OE (Output Enable), OR0-OR8 (Data Input), OS (Output Status), and ODR (Output Data Register) signals. Key timing parameters are labeled:  $T_{PD}$  (Propagation Delay),  $T_{DVR}$  (Data Valid to Output Delay),  $T_{DOL}$  (Output Delay to Data Valid),  $T_{DOR}$  (Output Delay to Register),  $T_{OSH}$  (Output High to Status High Delay),  $T_{OSL}$  (Output Low to Status Low Delay),  $T_{OEH}$  (Output Enable High to Output High Delay), and  $T_{ODL}$  (Output Delay to Low). The diagram also shows the data valid period and the new data valid period.

1. DATA, IR<sub>0</sub>-IR<sub>8</sub>, must be stable in T<sub>DIS</sub> nsec, or less, after IS is at a high level input voltage, V<sub>IH</sub>.
2. Three-state inputs/outputs are under control of IE/OE and require a maximum of 500 nsec to settle after an IE/OE transition.

**Figure 5.**

# EXPANSION EXAMPLE

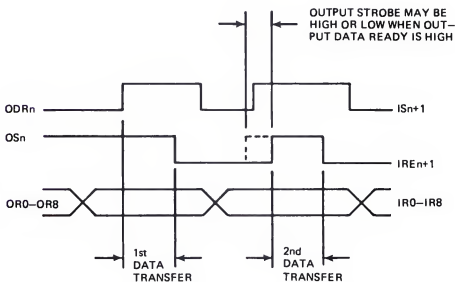
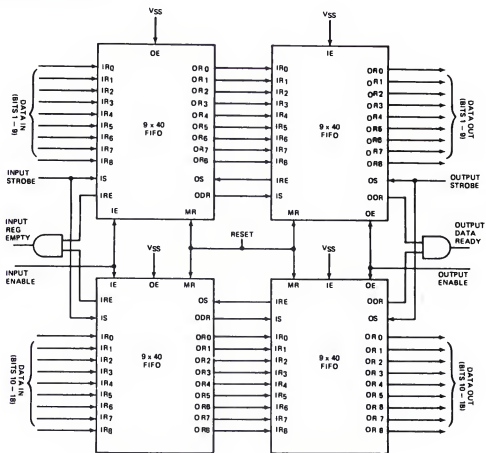


Figure 6. Interchip Timing — Expandable Memory Operation



device has processed the data, the OS line (which has been high) is strobed low. The negative going edge of the OS line will reset the ODR signal to a low state, indicating that a new word is being transferred to the output register. The OS signal may be strobed low concurrently with the rising edge of the OE signal. The FIFO can take up to a maximum of 500ns. before the OER signal is reset by the negative edge of the OS. Data will remain valid for as long as the ODR signal is high. The OS signal must remain in the low state for a minimum of 300ns. The OS signal must remain high for at least 200ns. before it can again be strobed low.

These timing relationships are shown in more detail in Figures 4 and 5. Table 1 lists all the timing characteristics for the FR1502 and the two (2) slower members of the family. In order to meet the maximum data transfer rate of 1 MHz. optimum use must be made of the handshaking signals provided by the chip. When operating at lower data rates the design is more forgiving and the control can be done with less trouble. In one case, using a 200 KHz data transfer rate, it turned out not to be necessary to use the IRE signal at all as the chip was always ready to accept new data before the external logic presented it.

Table II provides a list of the electrical characteristics of the FR1502 series. As can be seen from the logic levels the device is TTL compatible. However, the FIFO can only drive one normal TTL load as  $I_{OL}$  is 1.6ma.

The FR1502E requires a source of -12V. for proper operation, and the device is not particularly a power miser. Approximately .33 watts of power is required from the +5V. supply and about .36 watts is required from the -12V. supply. Also please note, the FIFO is only specified from 0-77 degrees C.

Figure 6 illustrates the method used to expand the FIFO size. In the example the memory has only been

expanded to 18 bits wide by 80 bits deep, but the method is the same for greater expansions. If the IRE and the ODR signals are being used, gates must be included to insure that IRE does not go high until all the FIFOs are ready to accept data, and similarly the individual ODR signals must be ANDed to insure that a composite ODR signal reflects the status of all the chips.

As can be seen, this chip provides an extremely easy method to interface two devices having different and nonsynchronous data rates, and the input rate is higher than the accepting device can process asynchronously.

TABLE 1

SWITCHING CHARACTERISTICS — SEE "SWITCHING WAVEFORMS"							
(V <sub>SS</sub> = V <sub>CC</sub> = 5V, V <sub>DD</sub> = 0V, V <sub>GG</sub> = -12V, T <sub>A</sub> = 25°C, C <sub>LOAD</sub> = 10 PF)							
SYM	PARAMETER	FR1502E		FR1502E-01		FR1502E-02	
		MIN	MAX	MIN	MAX	MIN	MAX
T <sub>IES</sub>	INPUT ENABLE SET TIME	350NS		700NS		1400NS	
T <sub>DIS</sub>	DATA INPUT SET TIME		150NS		300NS		600NS*
T <sub>ISH</sub>	INPUT STROBE HIGH TIME	175NS		350NS		700NS	
T <sub>DIH</sub>	DATA INPUT HOLD TIME	75NS		150NS		300NS	
T <sub>IRL</sub>	INPUT REGIS- TER LOAD TIME		325NS		650NS		1300NS
T <sub>IEH</sub>	INPUT ENABLE HOLD TIME		0NS		0NS		0NS
T <sub>IRE</sub>	INPUT REGIS- TER EMPTY TIME		825NS		1650NS		3300NS
	INPUT STROBE						

Branch to page 92

Branch to page 92

# MICRO SYSTEMS SPECIALIST!!



## People's Computer Shop

13452 VENTURA BLVD., SHERMAN OAKS, CA

### People's Application Systems

- General Ledger System for CPA
- Financial Analysis & Control
- Management Science Programs
- Medical Management System
- Market Strategy Programs
- Scientific Subroutines

Full systems support with our unmatched hardware & software maintenance

### BANK FINANCING AVAILABLE

Hours: 12:30 Tue-Fri  
10-6 Sat  
12-6 Sun



743 KSR



8K, 16K MEMORIES  
MINI, FULL SIZE DISKS



PRINTER TERMINALS

# XiMEDIA PRESENTS

## The SOROC IQ120

**CURSOR CONTROL.** Forespace, backspace, up, down, new line, return, home, tab, PLUS ABSOLUTE CURSOR ADDRESSING.

**TRANSMISSION MODES.** Conversation (half and full Duplex) PLUS BLOCK MODE — transmit a page at a time.

**FIELD PROTECTION.** Any part of the display can be "protected" to prevent overtyping. Protected fields are displayed at reduced intensity.

**EDITING.** Clear screen, typeover, absolute cursor addressing, erase to end of page, erase to end of line, erase to end of field.

**DISPLAY FORMAT.** 24 lines by 80 characters (1,920 characters).

**CHARACTER SET.** 96 characters total. Upper and lower case ASCII.

**KEYBOARD.** 73 keys including numeric key pad.

**REPEAT KEY.** 15 cps repeat action.

**DATA RATES.** Thumbwheel selectable from 75 to 19,200 baud.

**SCREEN.** 12 inch rectangular CRT — P4 phosphor.



### SPECIAL INTRODUCTORY PRICING

Kit \$ 995.00      Assembled \$ 1,295.00

*(Price includes block mode, lower case and 24 line options.)*

### Specials of the Month

North Star Micro Disk  
with power supply and cabinet . . . . . Kit — \$699  
Assembled — \$799

IMSAI I-8080 with TDL ZPU . . . . . Kit — \$825  
Assembled — \$975

Digital Systems FDS Disk Drive with  
CP/M Software (assembled only) . Single — \$1,750  
Dual — \$2,350

Mountain Hardware PROROM . . . . . Kit — \$145  
Assembled — \$210

Vector Graphic 8K RAM . . . . . Kit — \$235  
Assembled — \$285

**NOW WE'RE  
TOLL FREE  
800-227-4440**

(in California, Hawaii, and Alaska, call collect:  
415/566-7472)

*XIMEDIA OFFERS A FULL RANGE OF PRODUCTS FOR THE PERSONAL COMPUTER ENTHUSIAST AND THE SMALL SYSTEM DESIGNER. LET US QUOTE ON ALL YOUR HARDWARE AND SOFTWARE NEEDS.*

*OUR RETAIL STORE — THE COMPUTERIST™ — IS NOW OPEN IN SAN FRANCISCO. CALL US FOR DIRECTIONS.*

## XiMEDIA

1290 24th Avenue, San Francisco, CA 94122  
(415) 566-7472

COD orders freight collect. Orders with payment shipped prepaid. California residents add 6% sales tax. Please allow 3 weeks for delivery.

# SPECIAL

SAVE \$200

ON

## IMSAI I-8080 KIT

WITH

22 SLOT MOTHERBOARD

6 EDGE CONNECTORS

**ONLY \$575**

SPECIAL SPRING SALE

Save over \$200 (26%) off the regular list price on this IMSAI I-8080 package (Reg. \$780). This sale price may expire June 30, 1977 or until supplies are gone. These are the latest IMSAI I-8080s, so hurry and send in your order. Send cashier's checks, certified checks, or money orders for faster delivery times, as personal checks have to clear before your order can be sent out. Discounts on other items, too.

IMSAI, Processor Tech, TDL, Solid State Music, Seals Cybercom, Oliver Audio Eng., Cromemco, Dajon, DigiCom

Bits, Bytes & Pieces

(916) 726-6469

6211 QUINCEWOOD CR., CITRUS HEIGHTS, CA. 95610

CIRCLE INQUIRY NO. 62

# COMPUTERSTORE

### Mail Order Computer Store

IMSAI 8080 kit with 22 slots (limited quantity) . . . . .	\$ 599.00
IMSAI 4k RAM . . . . .	129.00
IMSAI 16k RAM . . . . .	419.00
IMSAI 32k RAM . . . . .	699.00
IMSAI 64k RAM . . . . .	2,459.00

When Ordered With Kit

TERMS: Shipping charges — \$10. per CPU or large units. \$1.50 per kit, \$2 minimum per order.  
Provided stock is available, we ship immediately for payment by cashiers check or money order.  
Allow 3 weeks for personal checks to clear.  
Nevada residents, please add appropriate tax.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PLEASE, NO PHONE ORDERS ACCEPTED

Phone: (702) 734-1104

Write: **Metatec Corporation**  
3453 Industrial Road  
Las Vegas, NV 89109

CIRCLE INQUIRY NO. 82

T <sub>ISL</sub>	LOW TIME	200NS	400NS	800NS
T <sub>OES</sub>	OUTPUT EN- ABLE SET TIME	ONS	ONS	ONS
T <sub>PD</sub>	INPUT/OUTPUT PROPAGATION DELAY	500NS	1000NS	1500NS
T <sub>OSL</sub>	OUTPUT STROBE LOW TIME	300NS	600NS	1200NS
T <sub>ODR</sub>	OUTPUT DATA RESET TIME	500NS	1000NS	2000NS
T <sub>ODV</sub>	OUTPUT DATA VALID TIME	75 NS	150NS	300NS
T <sub>DR</sub>	DATA RESET TIME	400NS	800NS	1600NS
T <sub>OEH</sub>	OUTPUT EN- ABLE HOLD TIME	ONS	ONS	ONS
T <sub>ODL</sub>	OUTPUT DATA READY LOW TIME	500NS	1000NS	2000NS
T <sub>OSH</sub>	OUTPUT STROBE HIGH TIME	200NS	400NS	800NS
T <sub>R</sub>	MAXIMUM RIPPLE TIME	20US	40US	80US
F <sub>D</sub>	MAXIMUM DATA RATE	1MHz	500KHz	250KHz

FOR CONDITIONS, SEE FIGURE 1, NOTE 1.

TABLE II

### MAXIMUM RATINGS

V <sub>GG</sub> Supply Voltage	+ 0.3V to - 20V
V <sub>DD</sub> Supply Voltage	+ 0.3V to - 20V
Clock Input Voltage*	+ 0.3V to - 20V
Logic Input Voltage*	+ 0.3V to - 20V
Logic Output Voltage*	+ 0.3V to - 20V
Storage Temperature	- 55°C to + 150°C
Operating Free-Air Temperature	0°C to + 70°C
T <sub>A</sub> Range	0°C to + 70°C
Lead Temperature (Soldering, 10 sec.)	300°C

\*V<sub>GG</sub> = V<sub>DD</sub> = OV

NOTE: These voltages are measured with respect to V<sub>SS</sub>(Substrate)

### ELECTRICAL CHARACTERISTICS

(V<sub>SS</sub> = V<sub>CC</sub> = 5V ± 5%, V<sub>DD</sub> = OV, V<sub>GG</sub> = + 12V ± 5%,  
T<sub>A</sub> = 0°C to + 70°C unless otherwise specified)

SYMBOL	PARAMETER	MIN.	MAX.	CONDITIONS
V <sub>IL</sub>	INPUT LOGIC LEVELS*			
V <sub>IH</sub>	Low-level Input Voltage	V <sub>SS</sub> - 1.5V	0.8V	V <sub>SS</sub> = 4.75V
	High-level Input Voltage			
V <sub>OL</sub>	OUTPUT LOGIC LEVELS*			
	Low-level Output Voltage	V <sub>SS</sub> - 1.0V	0.4V	V <sub>SS</sub> = 5.25V I <sub>OL</sub> = -1.6mA V <sub>SS</sub> = 4.75V I <sub>OH</sub> = 200 A
V <sub>OH</sub>	High-level Output Voltage			
I <sub>IL</sub>	INPUT CURRENT*			
	Low-level Input Current (each input)		-1.6mA	V <sub>SS</sub> = 5.25V V <sub>IN</sub> = 0.4V
I <sub>OS</sub>	OUTPUT CURRENT			
	Short-circuit Output Current*		-2.2mA	V <sub>SS</sub> = 5.25V V <sub>OUT</sub> = OV
I <sub>SS</sub>	SUBSTRATE SUPPLY CURRENT		65mA	V <sub>SS</sub> = 5.25V V <sub>GG</sub> = 12.6V
I <sub>GG</sub>	GATE SUPPLY CURRENT		30mA	V <sub>IN</sub> = 0.4V

\*\*Note more than one output should be shorted at a time.

Note: 1) Inputs under INPUT ENABLE control when disabled (V<sub>IH</sub> applied to IE), are logically and electrically disconnected and caused to float.  
2) Outputs under OUTPUT ENABLE control when disabled (V<sub>IL</sub> applied to OE), are logically and electrically disconnected and caused to float.

The Three-State Output has three states:

- (1) Low Impedance to V<sub>CC</sub>
- (2) Low Impedance to GND
- (3) High Impedance OFF ~ 10 Megohm.

# PUT A MACRO IN YOUR MICRO!



## TIMESHARING FOR A MICRO

Imagine playing Startrek to kill time while you wait for your computer to print out a complicated listing—but using the same computer.

Hardware limitations of the 8080 have made micro-computer timesharing impractical for the personal computer enthusiast. The AM-100™ 16-bit microprocessor set puts at your command a system which easily accepts multi-tasking from a multiple user structure. In addition the AM-100™ system lets you control priorities and allocate memory requirements for each job activated. There is even a security system to prevent unauthorized access to the data files (a Macro Computer?).

- Teachers—have each student at a terminal at the same time running a learning program. Monitor the progress on your master terminal.
- Computer Stores/Amusement Parks—set up a game bank with one computer and eight terminals. Have different games on each screen.
- Businessmen—put a terminal on the desk of your bookkeeper, stock clerk and design engineer. Perform the daily accounting, inventory control and design problems at the same time. Hook a terminal in the shop and audit production schedules with the processor's real-time clock.

## WESTERN DIGITAL MICROPROCESSOR

The AM-100 is based on Western Digital's advanced WD-16 microprocessor chip set (the same one used to create the DEC LSI-11). It has been re-microprogrammed to give a more flexible macro instruction set while still maintaining the general architecture and source code format of the popular PDP-11 series.

## S-100 BUS COMPATIBILITY

The 16-bit processor system interfaces to the 8-bit S-100 bus by multiplexing through 70-plus TTL logic chips. This multiplexing is totally transparent to the programmer.

See unit on display at our **BYTE SHOP** retail stores:

813 N. Scottsdale Rd.  
Tempe, Arizona 85281  
(602) 894-1129

12654 N. 28th Dr.  
Phoenix, Arizona 85029  
(602) 942-7300

2612 E. Broadway  
Tucson, Arizona 85716  
(602) 327-4579

## ALPHA BASIC COMPILER

The BASIC language processor implemented is a compiler as opposed to the more popular interpreters. It reads the source code statements and generates a compacted and fully resolved object code program. The object code program is then executed by a special runtime package which is reentrant and may be shared by several users at once. The source code need not be present during this execution thereby reducing memory requirements.

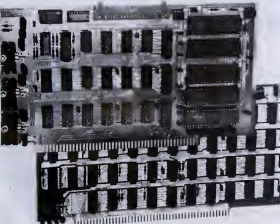
## FOR THE SYSTEM USER

- Conversion starts as low as \$1495 including full software
- MicroAge will provide you with the best support hardware in memories, terminals and I/O systems
- Complete multi-user/multi-tasking systems available configured to your specification and needs
- Look to MicroAge to provide you with a full consulting service for small business, scientific and educational computer systems
- User implementation is provided anywhere in the United States along with maintenance and service programs

Write or call us for further information and details:

**MICROAGE™**

P.O. Box 28106  
Tempe, Arizona 85282  
Phone: (602) 894-1129



Introducing the AM-100™ by Alpha Microsystems: A 16-bit microprocessor CPU (2-card set) that replaces the 8080 microprocessor in your S-100 bus type computer.

- Eight 16-bit registers
- Multi-level DMA and vectored interrupt system
- Real-time clock on the CPU board
- Hardware supported totally relocatable object code
- Multi-user multi-tasking timeshared operating system
- Multi-user structured file system with passwords
- Multiple pass macro level assembler and linking loader
- Floppy disk file management system and utilities
- Up to 10 times the throughput of an 8080 system
- Fully supports most S-100 peripherals without modification
- ALPHA BASIC™ extended compiler and run system (not an interpreter)
- Free-form text editor and letter-writing text formatter
- System generation program to create custom operating system monitors
- Completely device independent with logical file I/O calls

# synchro-sound enterprises

## "THE COMPUTER PEOPLE"

**NEW FULLY ADDRESSABLE  
CURSOR**



### LEAR-SIEGLER MODEL ADM-3A

#### CHARACTER GENERATION

5 x 7 dot matrix.

#### DISPLAY FORMAT

Standard: 1920 characters, displayed in 24 lines of 80 characters per line.

#### CHARACTER SET

Standard: 64 ASCII characters, displayed as upper case, plus punctuation and control.

#### COMMUNICATION RATES

75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200 baud (switch selectable).

#### COMPUTER INTERFACES

EIA standard RS232C and 20 mA current-loop (switch selectable).

**ALL ITEMS IN STOCK**



**IMSAI 8080 MICROCOMPUTER**  
**POWERFUL • EASY TO USE • LOW COST**  
**IMSAI 8080**  
**619.95 /22 SLOT BOARD**



**OKI DATA PRINTER**

### OKIDATA MODEL 110

**110 CPS DOT MATRIX LINE PRINTER**

**FRICTION FEED**

**1099.00**

**TRACTOR FEED**

**1229.00**

**RS 232 C SERIAL INTERFACE**

**250.00**

### LEAR SIEGLER ADM-3A

**KIT**  
**839.95**

**WIRED**  
**1099.00**  
**89.00**

### LOWER CASE

**FOLLOWING ITEMS IN STOCK: TDL,  
 OAE, PROCESSOR TECH, COMPUCOLOR,  
 HAYDEN, TARBELL, LEAR SEIGLER,  
 OKIDATA, IMSAI, JAVELIN**

**\* SPECIAL \***

2708 E Proms  
 Set of 7, \$40.00 each



193-25 JAMAICA AVE  
 JAMAICA, N.Y. 11423  
 HOURS: 9-4 TUES — SAT  
 VISIT OUR NEW SHOWROOM  
 (212) 468-7067



# CARD-OF-THE-MONTH

## POLY I/O IDEABOARD

A Versatile Prototyping board  
for S-100 Bus systems.

Roger H. Edelson, Hardware Editor

This month I'll be reporting on a board that many of you could live your whole life without ever needing — but some of us are extremely happy that PolyMorphic Systems introduced this card. The Poly I/O Ideaboard is a card designed for the computer enthusiast who wants to "do his own thing". In general, all the circuitry used for any Input/Output application is provided on the board and the designer is free to work on his own application design.

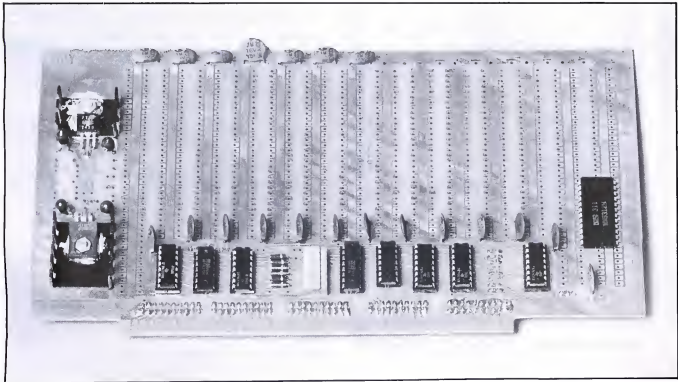
The POLY I/O board is designed as a wirewrap prototyping board that is compatible with S-100 Bus computers both physically and logically. The board is configured such that the I/O decoding can be either as an I/O Port or as a memory mapped I/O.

Let's take a look at the physical layout of the kit before we delve into the logical design. The board is, as previously mentioned physically compatible with the S-100 bus systems. It is a high quality printed circuit board on a glass base. All the etch is tinned and the edge board connectors are gold plated for reliability. No solder masking is used as it would not be appropriate for a user customized device. The component identification is skimpy, but adequate, as the layout diagram is very complete. All the ICs for the I/O function provided by PolyMorphic Systems have sockets. Wire-wrap connectors are provided for wiring to the S-100 Bus pins. A

single +5 V. regulator and associated filter capacitors are provided, as well as space and some printed wiring traces for one additional I/C regulator. Space, and some hookup configuration has also been provided for two zener voltage regulators. It is therefore possible to provide up to four different voltage supplies on the card.

Generous prototyping space is provided, enough for up to 59 16-pin IC sockets. The solder pads are laid out so that 24-, 28-, or 40-pin devices may also be mounted. When these wider spaced ICs are used, one line of solder pads is covered by the chip; a small price to pay for the universality of the board.

The construction of the board is extremely easy, taking no more than one-half hour. Care must be taken in soldering the components because of the absence of any solder masking, but no particular problems were encountered. Adequate power and ground bus trace is provided to minimize circuit noise. Solder pads for noise decoupling capacitors are provided at each end of the IC mounting lines, unfortunately PolyMorphics provides only ten  $\cdot 1 \mu\text{Fd}$ . capacitors, while providing space for 26 capacitors. The problem is to provide sufficient parts for most applications, while keeping the cost reasonable. If the designer needs to completely fill the board with parts, he will have to add some of his own decoupling capacitors. The same dilemma is undoubtedly responsible for the lack of any wire wrap sockets for the





# computer enterprises

Your Mail Order Computer Shop...

IMSAI 8080 kit with 22 slots (limited quantity) ..... \$599.00  
 TDL-80 ZPU (the one with full software available now) 242.00  
 Edge Connectors and guides for IMSAI each ..... 4.25  
 Edge Connectors and guides for IMSAI 10 for ..... 40.00  
 Seals 8k RAM kit with 500 ns chips ..... 225.00  
 Seals 8k RAM kit with 250 ns chips ..... 260.00  
 North Star complete Micro-Disk System kit ..... 599.00



WETAKE  
 MASTER CHARGE OR BANKAMERICARD  
 For phone and mail orders.  
 (Add 4% of TOTAL ORDER for service charge)



TERMS: Shipping charges — \$10. per CPU or large units, \$1.50 per kit, \$2. minimum per order.  
 Provided stock is available, we will ship immediately for payment by cashiers check or money order.  
 Allow 3 weeks for personal checks to clear. New York State residents add appropriate sales tax.  
 PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

For the best prices available on:

IMSAI • TDL • NORTHSTAR • POLYMORPHIC  
 NATIONAL MULTIPLEX • SEALS ELECTRONICS

CALL: (315) 637-6208  
 WRITE: P.O. Box 71 • Fayetteville, N.Y. 13066

CIRCLE INQUIRY NO. 71

TO  
 SERVE  
 YOU  
 BETTER!



Digital Group  
 IMSAI  
 Lear-Siegler  
 Okidata  
 Pickles & Trout  
 PolyMorphic Systems

Processor Technology  
 Solid State Music  
 Soroc  
 Tarbell  
 TDL  
 Vector Graphic

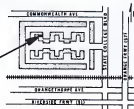
New! North Star

**BITS N BYTES #2** in San Diego!

Call (714) 421-1041

**BITS N BYTES**

679 "D" S. STATE COLLEGE BLVD  
 COLLEGE BUSINESS PARK  
 FULLERTON, CA. 92631  
 (714) 879-8386  
 HOURS: 12-7 P.M. M-F  
 12-5 P.M. SAT.



CIRCLE INQUIRY NO. 63

experimenter-designed circuitry. The question would be: how many, of which socket should be provided. PolyMorphic has refrained from trying to cut the Gordian Knot by simply forcing the user to purchase his own sockets.

Again, as I said earlier, the board goes together very easily and no assembly problems were encountered.

Let's now take a look at what PolyMorphic has provided as far as the I/O circuitry. The design includes address decoding which, though not completely general, is probably sufficient for most requirements. Read and write strobes, four separately addressed, and tri-state data buffers are provided. As mentioned earlier, a +5 volt regulator and associated circuitry is also included in the kit. Both individual and ganged wire-wrap pins are also provided.

Figure 1 is the schematic for the Poly provided I/O addressing. The data lines are buffered both for Input and Output by SN74367 Tri-State buffers. Both the input and output buffers are under control of their respective strobes. A0 and A1 are used in conjunction with a 74LS14 dual two-line-to-four line decoder to provide four addressed read/write strobes. The A0 and A1 lines are buffered by a 74LS14 to schmidt trigger to provide noise immunity.

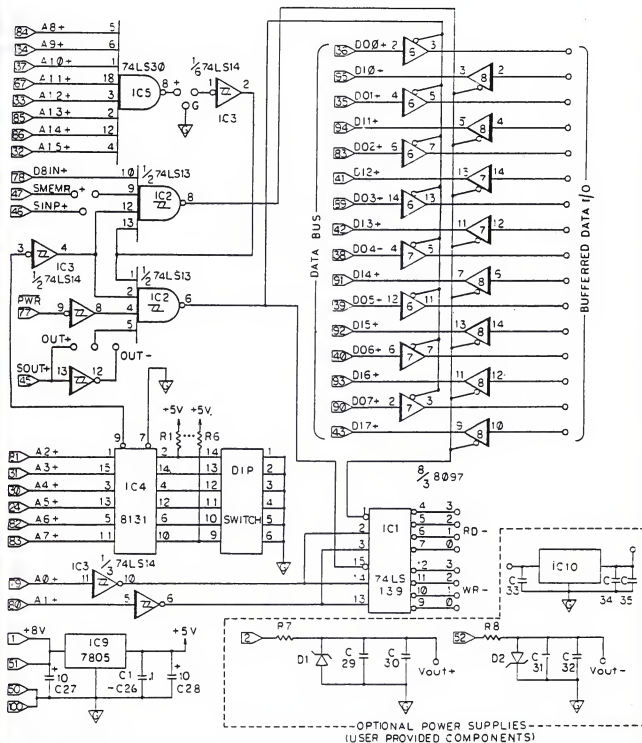
Board addressing may be done with input or output instructions as with any Port, or with memory addressing in the memory mapped mode. The mode selection is done by jumpers. In either the normal (port) mode or the memory-mapped mode the user can set the dip switch to select any address provided by address lines A2 through A7. In the memory-mapped mode the board is placed at location FFxx by the action of the eight-input NAND gate IC5. In the memory-mapped mode all the inputs to this gate (A8 through A15) must be high to allow generation of the read/write strobes. In the normal mode this gate is jumpered out of the circuit. If the memory mapped-mode is selected then SMEMR must be jumpered to pin 9 of IC2. If instead, the normal (PORT) mode is desired, S1NP must be connected to this pin. A selection of the appropriate connection of SOUT must also be made. If the user desires to use the memory-mapped mode, the SOUT - must be connected to Pin 5 of IC 2. In the normal mode this pin is connected to SOUT+ . The outputs of IC 2 besides being used to control the state condition of the Tri-State Data buffers, also controls the ENABLE line on the 74LS139 to insure that no strobes are generated unless the correct addressing conditions are met.

When a low is present at either of the ENABLE inputs to the LS139 the low order address bits are decoded. Depending on the condition of A0 and A1 one out of the four possible strobes is generated. Table I indicates the addressing of the strobes.

Table I.

Read Strobe Enabled	Enable (pin 1)	A0	A1	Write Strobe Enabled	Enable (pin 1)	A0	A1
none	HI	X	X	none	HI	X	X
RD0	LO	LO	LO	WR0	LO	LO	LO
RD1	LO	LO	HI	WR1	LO	LO	HI
RD2	LO	HI	LO	WR2	LO	HI	LO
RD3	LO	HI	HI	WR3	LO	HI	HI

It is unfortunate that PolyMorphic did not choose to allow full decoding of the eight high order address bits. For example, in my system the monitor resides in memory above location F0. This makes it impossible for me to use the memory-mapped mode with the Poly Idea-



**Figure 1.**

# FREE

SYSTEM SELECTION ADVICE. WE WILL HELP YOU TO CHOOSE FROM THE BEST OF EACH MANUFACTURER TO COMPLETE THE SYSTEM BEST SUITED TO YOUR NEEDS, COME SEE AND TRY:

PROCESSOR TECH.  
SOL-20 SYSTEM  
TDL ZPU ZIGK  
CROMEMCO  
POLYMORPHIC  
VECTOR GRAPHICS  
IMSAI  
SWTP  
INTEL  
BYTE

ICOM DISCS  
NORTH STAR  
TARBELL  
SEALS  
DYNABYTE  
LEAR ADM-3A  
COMPUCOLOR  
SOROC  
SANYO  
HITACHI

ALPHA MICRO 16 B  
OKIDATA  
DECWRITER  
MULTITERM  
S R POLYPHONIC  
COMPUTALKER  
S S MUSIC  
I C S SOCKETS  
TOOLS SUPPLIES  
BOOKS MAGAZINES

LAWDALE

**BYTE SHOP**  
the affordable computer store

16508 HAWTHORNE BLVD.

LAWDALE, CA 90260

(213) 371-2421

HRS: TUE.-FRI. 12-8, SAT. 10-6

BANKAMERICARD • MASTERCARD • AMERICAN EXPRESS



CIRCLE INQUIRY NO. 68



**COMPUTER MART**

## A NEW YEAR, A NEW LOGO, A NEW STORE!!!

Last year we opened the first computer store on the East Coast. This year we moved out of the Hobby Store and into our new Real Systems Showroom and Store. The largest display of up-and-running computer equipment. The same friendly help and advice. Plus - all the bits and pieces you can't find elsewhere! Plain and Fancy Software, too! IMSAI, PROCESSOR TECHNOLOGY, SOUTH WEST TECHNICAL PRODUCTS, DIGITAL GROUP, OSI, VECTOR GRAPHICS, ALPHA MICRO TECHNOLOGY, CROMEMCO, COMPUCOLOR, POLYMORPHIC SYSTEMS, SOROC TERMINALS, SEALS, TARBELL, MORROW, TDL, NORTH STAR, QUAY, APPLE, OLIVER, SMOKE SIGNAL, MULLEN, GBC MONITORS, O.K. MACH, CONT. SPEC. VECTOR, E&L INST. and - COMPUTER MART PRODUCTS. More coming!!

—Stan Veit, Storekeeper

**COMPUTER MART OF NEW YORK INC.**  
118 MADISON AVE. (ENTER ON 30th ST.)  
(212) 686-7923

CIRCLE INQUIRY NO. 75

board. An 8130 and a buffer for the address lines could have been used. Combined with a ten-pole dip switch this would have provided completely flexible addressing. However, even without this capability the Ideaboard is still extremely versatile.

The use of an 8131 for address decoding is a very nice idea as the bus inputs are high impedance inputs so as to not load the S-100 bus.

As we have seen, with the exception of the lack of a fully general addressing scheme, the Poly I/O Ideaboard is a very handy device to have around the shop if you like to "brew your own". I have used mine for audio outputs and to design some specialized cards for a dedicated microprocessor application. The use of wire-wrapping makes the card extremely versatile and reusable.

One of the very nice features of the Ideaboard is the very extensive checkout and test section of the applications manual. Test programs are provided for both the normal mode and the memory mapped mode. Both programs are reproduced here with the kind permission of PolyMorphic Systems. Besides the programs PolyMorphic also gives troubleshooting instructions to fault isolate to the defective chip. All of this makes the board very easy to get running.

Additionally there is a section in the manual on installation of customer-provided voltage regulators. The circuit board is set up to accept either 78XX or 79XX series regulators of their equivalent 340 or 320 series devices. The board layout for this regulator and a pair of Zener regulators are shown in Figure 2. In the case shown the Zeners provide both positive and negative voltages from the S-100 Bus unregulated supplies.

The zener regulators typically consist of an input register, a 10μf tantalum capacitor, a 0.1μf ceramic capacitor, and a zener diode. The input resistor value can be calculated as follows: Measure the input voltage to be used (approximately +20 or -20 volts) with the D.C. scale on a voltmeter. Subtract the desired output voltage. Subtract 25% of the remainder. Divide by the maximum current to be used by your circuitry.

$$R_{IN} = \frac{V_{IN} - V_{OUT}}{I_{OUT}(\max)} \times 0.75$$

## ADDRESS

ADDRESS	HEX CODE	INSTRUCTION	COMMENTS
0C00	21 08 0C	BEG LXI H,MODIF+1	HL = address of port tested
0C03	36 0C	FFORT MVI M,C0H	set first port = C0
0C05	06 C0	MVI B,C0H	
0C07	D3 C0	MODIF OUT C0H	output to selected port
0C09	0E FF	MVI C,0FFH	select time between outputs
0C0B	04	INR B	next port
0C0C	78	MOV M,B	
0C0D	CD 1F 0C	OMT CALL TIME	wait 1/2 second
0C10	8C	INR C	
0C11	C2 00 0C	JNZ OMT	wait longer if reg C FF
0C14	78	MOV A,B	
0C15	E6 07	ANI 7	
0C17	FE 04	CPI 4	last port?
0C19	CA 03 0C	JZ FPORT	yes
0C1C	C3 07 0C	JMP MODIF	no
0C1F	11 00 00	TIME LXI D,0	timing loop
0C22	1C	LOOP INR E	

0C23	C2 22 0C	JNZ LOOP	
0C26	14	INR D	
0C27	C2 22 0C	JNZ LOOP	
0C2A	09	RET	; end of timing loop

Normal Mode Test—Start Address = 0C00 H1

If it is necessary to check an individual strobe line, adjust the program as follows:

#### Address Insertion

0C04	Port # - C0, C1, C2 or C3
0C06	Port # - same as 0C04
0C07	D3 for write strobe, DB for read strobe
0C0A	Two's complement of the number of times (1/2 second each) the timing loop is repeated - thus if you are checking one strobe, FC will give you four repetitions of the timing loop for a total of two seconds.
018	Hex equivalent of the two least significant binary digits of the port number 1, i.e. 01 for port C0, 02, for port C1, etc.

If you must relocate the program—i.e. your computer cannot use the program at the memory locations given—change the address codes in the program. That is, change the last two bytes of each three byte instruction except LXI D, 0. As an example, if you wish to re-locate the program to 4000 hex, change Memory-Mapped Mode.

Test—starting address = 0C00 hex

### MEMORY MAP MODE

ADDRESS	HEX CODE	INSTRUCTION	COMMENTS
---------	----------	-------------	----------

0C00	21 03 10C	BEG	LXI H, MODIF + 1 ; HL = address of ported tested
------	-----------	-----	--

0C03	36 C0	FADR	MVI M, C0 ; set first port address = FFC0
0C05	06 C0		MVI B, C0
0C07	32 C0 FF	M0DIF STA 0FFC0H	; output to port address
0C0A	0E FF	MVI C, 0FFH	; select time
0C0C	04	INR B	; between outputs
0C0D	70	MOV M, B	; next port address
0C0E	C0 20 0C	0MT	CALL TIME ; wait 1/2 second
0C11	0C	INR C	
0C12	C2 0E 0C	JNZ 0MT	; wait longer if reg C FF
0C15	78	MOV A, B	
0C16	E6 07	ANI 7	
0C18	FE 04	CPI 4	; last port address used?
0C1A	CA 03 0C	JZ FADR	; yes
0C1D	C3 07 0C	JMP MODIF	; no
0C20	11 00 00	LXI D, 0	; timing loop
0C23	1C	INR E	
0C24	C2 23 0C	JNZ LOOP	
0C27	14	INR D	
0C28	C2 23 0C	JNZ LOOP	
0C2B	C9	RET	; end of timing loop

If it is necessary to check an individual strobe line, adjust the program as follows:

#### Address Insertion

0C04	Port address - FFC0, FFC1, FFC2, or FFC3
0C06	Port # - same as 0C04
0C07	2A for write strobe, 3A for read strobe
0C0B	Two's complement of the number of times (1/2 second each) the timing loop is repeated - thus if you are checking one strobe, FC will give you four repetitions of the timing loop for a total of two seconds.
0C19	Hex equivalent of the two least significant binary digits of the port address plus 1, i.e. 01 for FFC0, 02 for FFC1, etc.



## JOURNEY WITH US ON A COMPUTER ODYSSEY

A new age is dawning.  
An age of computers, as they need men  
In his everyday existence.

The future is now.  
At Computer Playground we have computer games that  
test your skill and imagination, courses that  
introduce you to the world of computers, plus hardware  
in both packaged and kit form.

Come visit the future at:

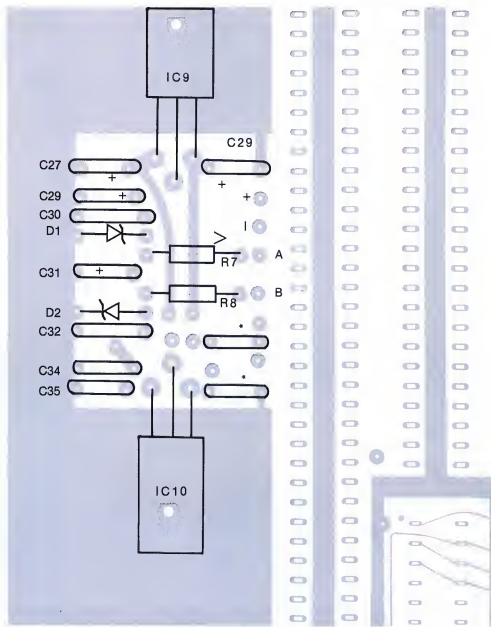
### Computer Playground

6789 Westminster Avenue  
Westminster California 92683

(714) 898-8330

40 min. south of L.A., one-mile east of the San Diego Freeway in Westminster Center

Bring this ad to Computer Playground and receive 15min. free game time.



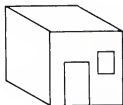
**Figure 2. Voltage Regulator Circuits**

\*One of these is C33; this depends on the manufacturer's specifications for the regulator used. The other is a jumper to provide ground to the regulator. All three leads must be jumpered.

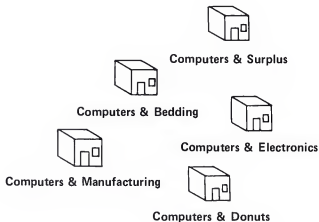
A. is +18 to 24 volts unregulated.

B. is  $\phi$ 18 to 24 volts unregulated.

# WE SPECIALIZE, OTHERS DON'T



Computer  
Store



If you have two businesses, you give half your attention to each of them, right?  
We have only one business, we're The Computer Store. Come to us for sound advice, we're

**THE MOST EXPERIENCED COMPUTER DEALERS ANYWHERE**

## THE COMPUTER STORE

820 Broadway  
Santa Monica, Calif. 90401  
Phone (213) 451-0713

Store hours: Tues-Fri: Noon — 8 pm  
Saturday: 10 am — 6 pm

Located 2 blocks North of  
the Santa Monica Freeway at  
the Lincoln Blvd. exit

**artair**<sup>mits</sup>  
COMPUTER CENTER

Authorized dealer for MITS, Cromemco, MECA, Logistics, Microterm, Technical Design Labs, Micro Computer Devices, North Star, Multiterm, Heuristics, Peripheral Vision, Oliver, Hitachi, Sanyo. BankAmericard and Master Charge welcome.





The Midwest Affiliation of  
Computer Clubs invites you  
to attend the Second Annual,  
Midwest Regional Computer  
Convention and Exposition....

JUNE 10, 11, 12

# COMPUTERFEST '77

BOND COURT HOTEL 777 St. Clair, Cleveland, Ohio

- > Manufacturers' Reps & Exhibits
- > Roofed Flea Market
- > Seminars & Tech Sessions
- > Club Congress
- > And Prizes, Games, Media Duping, and more....

Still only  
**2.00**  
per ticket

*The M.A.C.C. Convention is Where It's At in the Midwestern region.  
See you there! And if you plan to attend NCC, why not fly with us?  
Ask for information about the charter flight to Dallas. Drop a line to:*

**M** IDWEST **A** FFILIATION OF **C** OMPUTER **C** LUBS  
P.O. BOX 83, CLEVELAND, OHIO, 44141

## SUMMARY OF PROGRAMS FOR

This month's issue of *INTERFACE AGE* includes eight software articles, featuring three software development programs, one I/O interface driver program, two application programs, and two game programs. These programs include the following:

- A Motorola 6800 Hex Format To Intel Format converter program by Floyd Nordin provides capability of programming EPROM's in 6800 object code using an 8080 microcomputer software development system.
- A User TTY Handler For The Z-80 Development System written by Richard E. Maly provides three subroutines (SETUP, TRYOUT & TTYIN) and an INTERRUPT HANDLER for the Z-80 Microcomputer System.
- A Number Base Conversion Routine written in BASIC by John W. Swain provides program capability of converting numbers from any of the standard bases to another number basis and vice versa.
- A SEIKO Printer Hardware Interface & Software Driver by Philip Roybal provides hard copy output for the SCIMP microcomputer.
- A Checkbook Balance Program by Jim Huffman provides another practical application program for your microcomputer and at the same time helps justify to your wife the \$2,000 spent on your system instead of going skiing on your vacation last year.

## Software Bugs

MODIFICATIONS TO DR. WANG'S  
PALO ALTO TINY BASIC

Dear Editor:

I have discovered the following errors in "Dr. Wang's Palo Alto Tiny Basic" as described in the December 1976 issue:

1. The ASCII code for Escape is 1B (hex) rather than 7D, which is the code for "]" . This occurs in the GETLN routine at address 0514.
2. The INPUT command will not always work as a direct command since direct commands and input data are both stored in the same area of memory, starting at BUFFER. Thus, input data, if long enough, could overwrite remaining portions of the INPUT command.
3. The CHGSGN routine does not work properly for an argument of zero, causing error messages to be printed for expressions such as -0 or 0\*(-1). This problem can be cured with the following modification to the CHGSGN routine:

```
CHGSGN: MOV  A,H ;Test for zero argument
          ORA  L
          RZ      ;take no action for zero argument
;continue at this point with the entire original version of
;CHGSGN routine
```

Except for a few obscure programming tricks which could have been explained in the comments, such as using a two byte MVI instruction for "skip the next byte", I found the program listing fairly easy to understand.

Mark Hilmantel  
Nashua, NH

- A Logic Circuit Analysis Program for the 6502 by Robert Bishop provides binary state Truth Tables outputs of logic networks.
- An Apple STAR-TREK game program written by Robert J. Bishop provides a version of the well known STAR-TREK program in BASIC for the 6502 microcomputer system.
- John Conway's Game of Life program by Alan R. Miller not only provides another version of the Game of Life but also provides details on the type of life patterns encountered in the game.

## MICROCOMPUTER SOFTWARE DEPOSITORY PROGRAM LISTING

THE FOLLOWING LISTINGS ARE AVAILABLE FROM MSD ON A REPAID BASIS ONLY. THE TOTAL COST OF EACH PACKAGE IS THE SUM OF THE BASIC PRICE + CALIFORNIA SALES TAX, IF APPLICABLE, + POSTAGE AND HANDLING COST. PLEASE ADVISE IF YOU WISH THE DIFFERENT MAILING COST FOR POSTAGE OUTSIDE USA, ADDRESS ALL INQUIRIES TO:

MICROCOMPUTER SOFTWARE DEPOSITORY  
2341 F. FOOTHILL BLVD.  
PASADENA, CALIF. 91107  
OR CALL ( 714 ) 449-0164

MICROCOMPUTER SOFTWARE DEPOSITORY (MSD) PROGRAMS DATE APRIL 1977 REV. B

PROGRAM MEDIA	NOTES
PTAC PAPER TAPE ASSEMBLY CODE	1 CALIF. SALES TAX REQUIRED
PTSC PAPER TAPE SOURCE CODE	FROM RESIDENCE OF CALIF.
PTTC PAPER TAPE OBJECT CODE	1 USA POSTAGE + HANDLING ON
PTSC PAPER TAPE BASIC CODE	THIRD CLASS USA POSTAGE +
PTAL PAPER TAPE ASSEMBLY LISTING	HANDLING ON SHIPMENT W/TF
PTSL PAPER TAPE SOURCE LISTING	STATION POSTAGE +
PTOL PAPER TAPE OBJECT LISTING	THREE TIMES THIRD CLASS
PTPL PAPER TAPE OBJECT DUMP	USA POSTAGE RATE/STANDARD
PTBL PAPER TAPE BASIC LISTING	OR SURFACE RATE POSTAGE
CTAL CASSETTE TAPE ASSEMBLY LISTING	POSTAGE + FLIP TIMES USA
CTSL CASSETTE TAPE SOURCE LISTING	POSTAGE RATE (ALTERNATE)
CTOL CASSETTE TAPE OBJECT LISTING	+ NEW PROGRAM LISTING
CTPL CASSETTE TAPE OBJECT DUMP	1 VENDOR SOFTWARE PACKAGE -
CTBL CASSETTE TAPE BASIC CODE	
CTCL CASSETTE TAPE BASIC LISTING	
HCAC XEROX HARD COPY OF ASSEMBLY CODE	
HCSC XEROX HARD COPY OF SOURCE CODE	
HCOC XEROX HARD COPY OF OBJECT CODE	
HCCS XEROX HARD COPY OF BASIC CODE	
HCCAL XEROX HARD COPY OF BASIC LISTING	
HCCAL F FULL SIZE XEROX HARD COPY OF ASSEMBLY LISTING	
HCCSL XEROX HARD COPY OF SOURCE LISTING	
HCCOL XEROX HARD COPY OF OBJECT LISTING	
HCCOL XEROX HARD COPY OF OBJECT DUMP	
HCCBL XEROX HARD COPY OF BASIC LISTING	
HTAL XEROX HARD COPY OF PRINTED TEXT	
PTTL PAPER TAPE TEXT LISTING	
CTTL CASSETTE TAPE TEXT LISTING	
MCBL XEROX HARD COPY OF SHAWMAN	
MSBL XEROX HARD COPY OF BINARY BOOTSTRAP LOADER	
MSBL XEROX HARD COPY OF HEX BOOTSTRAP LOADER	
MSBL PACKAGE PRICE INCLUDES ALL TYPING/PROGRAMS + WITH SYMBOL	

SUFFIX C= HAND ASSEMBLED CODE  
SUFFIX L= COMPILER FORMATTED LISTING  
SUFFIX D= DUMP SIZE IN OCTAL OR HEX  
SUFFIX F= FULL SIZE DUMP

DEFINITIONS:

ASSEMBLY LISTING: COMPUTER ASSEMBLED SOFTWARE PROGRAM LISTING THAT INCLUDES SYMBOLIC ASSEMBLY LANGUAGE SOURCE CODED INSTRUCTIONS WITH COMMENTS PLUS EQUIVALENT MACHINE LANGUAGE OBJECT CODED INSTRUCTIONS AND MEMORY ADDRESS ASSIGNMENTS FOR EACH INSTRUCTION ( SOURCE + OBJECT ).

ASSEMBLY CODE: SAME CONTENT AS ASSEMBLY LISTING BUT HAND ASSEMBLED.

SOURCE LISTING: SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT INCLUDES ASSEMBLY LANGUAGE SOURCE CODED INSTRUCTIONS WITH COMMENTS, SOMETIMES LINE STATEMENT NUMBERS ARE INCLUDED FOR EACH INSTRUCTION.

SOURCE CODE: SAME CONTENT AS SOURCE LISTING BUT HAND ASSEMBLED.

OBJECT LISTING: SOFTWARE PROGRAM LISTING RESULTING FROM COMPUTER SOFTWARE CONTROLLED ASSEMBLY PROCESS THAT ONLY INCLUDES MACHINE READABLE OBJECT CODED INSTRUCTIONS AND MEMORY ADDRESS ASSIGNMENTS.

OBJECT CODE: SAME CONTENT AS OBJECT LISTING BUT HAND ASSEMBLED.

HARD COPY: XEROX OR PRINTED COPY.

CODE: HAND ASSEMBLED CODE ( SOURCE, OBJECT, OR ASSEMBLY CODE ).

LISTING: COMPUTER FORMATTED LISTING.

DUMP: COMPUTER MEMORY DUMP.

MAY 1977

# COMPUTER WAREHOUSE STORE

DEPT 1-584 COMMONWEALTH AVE. BOSTON, MA 02215-617-261-2700-VISIT US: 9-9 WEEK; 9-6 SAT



## ONE DAY SHIPMENT

### USED PERIPHERALS FOR MICROSYSTEMS

#### HAZELTINE 1000 \$795

VIDEO DISPLAY TERMINAL + SHIPPING \$35 1b.  
12 LINES x 80 CHAR., TTY COMPATIBLE,  
5 x 7 DOT MATRIX, 525 LINE RASTER.  
BUILT & TESTED; PLUG & GO



#### ALL anASR 33's and MORE!

OLIVETTI TE318 - BACK IN STOCK!  
RS232 INTERFACE, QUIET OPERATION  
10 CPS, PRINTER, BUILT-IN PAPER TAPE  
READER/PUNCH, ELECTRIC TYPEWRITER  
KEYBOARD WITH ADDITIONAL 10 KEY  
NUMERIC PAD, YOUR CHOICE OF FRICTION  
OR SPROCKET FEED, LIGHTED PLATEN AREA  
FOR EASY READING, STANDARD PAPER AND  
TAPE, SUPPORTED BY OLIVETTI



\$875  
+ SHIPPING  
165 1b

**TECHTRAN 4100.....\$595** + \$25 SHIPPING  
TAPE CASSETTE DRIVE. CAN RUN DIRECTLY FROM TERMINAL  
INDEPENDENT OF CPU. FULL EDIT CAPABILITY.

**KDI ADTROL AR-21...\$95** + \$25 SHIPPING  
ELECTRO OPTICAL PAPER TAPE READER WITH 110V PS, STEP-  
PER MOTOR, 250 CHAR/SEC, FAN IN TABLE TOP HOUSING

**IBM 731 I/O WRITER \$750** + \$25 SHIPPING  
8 1/2" PLATEN, P/INFD, EBCDIC, U/L CASE, DUAL CLR RIBBON, 115V

#### CWS U-BUILD-IT SYSTEM \$599

+ \$35 SHIPPING  
MPU, CRT TERMINAL &  
AUDIO CASSETTE AT A  
ROCK BOTTOM PRICE !



SC/MP MICROCOMPUTER; 256 x 8 RAM, 512 x 8 ROM  
GREEN PHOSPHOR VIDEO MONITOR; 12" RASTER SCAN  
SWTPC 1024; 32 CHAR. x 16 LNS, ASCII KEYBOARD  
SWTPC AC-30 AUDIO CASSETTE INTERFACE

\*OTHER PACKAGE PLANS - SEND FOR OUR CATALOG

### TO ORDER EQUIPMENT

1. ENCLOSE CHECK FOR FULL PRICE PLUS SHIPPING CHARGES  
(KITS - ADD \$5 IF UNDER \$100; \$10 IF OVER)  
(FOREIGN RATES HIGHER)  
BANKAMERICARD & MASTERCARD ACCEPTED -  
SEND CARD NUMBER, EXPIRATION DATE, INTERBANK #
2. CLEARLY IDENTIFY SHIPPING ADDRESS
3. DESCRIBE ITEM BY MODEL NUMBER  
ALL MERCHANDISE WARRANTED

### A MUST FOR PERSONAL COMPUTING

SEND \$1 FOR OUR CATALOG

THE ONLY ONE OF ITS KIND! FULL DETAILS ON OUR  
COMPLETE LINE OF KITS & UNITS, REVIEWS OF OVER  
150 BOOKS, LISTS OF NEW & SURPLUS PARTS & "ALL  
ABOUT HOBBY MICROCOMPUTERS" - AN INTRODUCTION TO  
PERSONAL COMPUTING.

### SPECIAL DISCOUNTS! ON KITS & ASSEMBLED UNITS

SAVE UP TO 20% OFF KIT PRICE WHEN A PERIPHERAL IS  
PURCHASED AT THE SAME TIME. (\$200 MAXIMUM DISCOUNT)

PERIPHERAL PRICE OVER **\$900** → 20% OFF KIT  
PERIPHERAL PRICE OVER **\$250** → 10% OFF KIT  
PERIPHERAL PRICE OVER **\$95** → 5% OFF KIT

### GREEN PHOSPHOR \$150 VIDEO MONITOR

STANDARD 1V P TO P COMPOSITE VIDEO INPUT,  
16MHz BAND WIDTH, RASTER SCAN 12x12x13"  
WITH POWER SUPPLY, VIDEO AMPLIFIER, DRIVING CIRCUITRY  
VENTILATION MUFFIN FANS, 7x9" HORIZONTAL VIEWING  
CAPABLE OF 24 LINES x 80 CHAR., ANTIGLARE 1" ETCHED  
GRADIENT DENSITY FACE PLATE, P39 GREEN PHOSPHOR, ON/OFF  
BRIGHTNESS CONTROLS, 115vac, 60 W ... TRULY A COMMERCIAL  
UNIT BUILT TO WORK IN A DEMANDING ENVIRONMENT.



### DATAPoint 3300-200

THERMAL PRINTER **\$375** + \$25 SHIPPING  
PARALLEL PRINTER WITH ADDITIONAL CIRCUIT  
BOARDS TO PROVIDE SERIAL INTERFACE, PRINTS  
UP TO 30 CPS, 100vac PS USES WIDELY AVAILABLE  
NCR PAPER, 96 CH, ASCII, 80 COL, CRT COMPATIBLE 5x7  
DOT MATRIX, SOLID STATE WITH LESS THAN 25 MOVING PARTS.



### DATAPoint 2200-200 \$395

CONSOLE PRINTER  
BOTH UNIVAC & SINGER BUILT THESE  
PRINTER MECHANISMS WHICH OPERATE AT  
30 CPS FROM A ROTATING WHEEL. 65 CHAR.  
USES STANDARD FORM FEED PAPER, PINWHEEL  
IS INTERCHANGEABLE.  
UNIVAC 0769-06 PRINTER MECHANISM ONLY  
INCLUDES MOTOR/PRINT WHEEL ... \$195 + SHIPPING 75 1b.



### KITS ★ HIGHLIGHTS FROM OUR WIDE SELECTION ★

#### INSAI 8080 MICROKITS

8080A KIT 5 SLOTS.....\$699  
8080A KIT 22 SLOTS.....751  
4K MEMORY KIT.....139  
PIC-8 PRIORITY INTERRUPT.....125  
SERIAL I/O KIT.....125  
PROH 4-512 KIT.....165  
UCR-1 KIT.....55  
CABLE A KIT.....15  
STANDARD INPUT/OUTPUT INTERFACES,  
MANUALS, SOCKET SETS  
VIKING 100 PIN, HEAVY DUTY.....\$3.00  
SWTPC 6800.....\$395  
\*512 BYTES OF RMH \*SERIAL INTERFACE  
\*RS232 or 20 mA \*4K of RAM  
4K MEMORY.....\$100  
MPA.....145 MPB.....40  
MPC.....40 MPD.....35  
MPE.....14 55 MPF.....30  
MPG.....65 MPH.....35  
MPI.....35 MPJ.....35  
MPK.....35 MPN.....35  
MPO.....14 50 MPQ.....14 50  
MPP.....14 50  
MPS, MPD, MPB, EACH.....9 50  
CONNECTOR SETS MPU/MPI.....2 50  
CONNECTOR SETS INTERFACE.....2  
AKBA.....5 G61.....99  
AC30 AUDIO INTERFACE.....79 50  
PP40 PRINTER.....250  
CT 1024 TERMINAL KIT.....275  
CTP.....15 50 CTS.....39 50  
ALL SWTPC UNITS ARE KITS  
SNOKE SIGNAL BROADCAST 16K RAM \$95

#### LEAR SIEGLER ADM-3A

W/ Cursor Control  
\*13" CRT  
\*25 Lx 80 Char  
\*RS232  
\*20 MA LOOP **\$875**

SCAMP KIT.....\$599  
FROM NATIONAL SEMICONDUCTOR  
KEYBOARD KIT.....95

★ BUILT UNITS ★  
ICOM MICROFLOPPIES  
PLUS COMPATIBLE FOR:  
\$100 BUS.....\$1095  
SINGLE DRIVE F02402.....\$ 649  
ICOM FLOPPY  
F36-1 FRUGAL.....\$1195  
F36-2 DUAL FRUGAL.....1295  
360-50 BRT/INTFC 8080.....300  
5171 POWER SUPPLY.....250  
F0360-2 DUAL SYSTEM.....3000

KIM-16502.....\$245  
512-2 4K.....175  
KIM-3 8K.....289  
MANUALS PACKAGE.....15  
TABLET AUDIO CASSETTE KIT 120  
INTERFIL INTERCEPT JR \$281  
12K RAM.....145  
ROM/PRGM BOARD.....74 65  
Y-40 AUDIO GRIPS.....81 50  
SERIAL I/O.....81 50  
AUDIO VISUAL BOARD.....125

RRR ZRMPH	ZR MITS IPV EXTEND BASIC PATCHES BY MARTIN D. DUB - INTERFACE AGE, MARCH 1977, VOL.2#4.	39-TEXT * 0 39-HCALF * 39-PACK * 0	1.07+0.0+1.00 1.07+0.0+1.00	RRR MMTSE	GRAPHICS - THE EASY WAY BY MARVIN MALLON - INTERFACE AGE, MARCH 1977, VOL.2#4.	48-TEXT 0 48-HCALF 0	3.00+0.10+1.00 5.00+0.30+1.00
ARR HJAST	ARM APPLE STAIN-TREK RY ROBERT J. RISHOP -	40-TEXT * 0 40-HCALF * 40-PACK * 0	3.00+0.10+1.00 INC. WITH TEXT	RRR CRMS	RYTHMOVER SOFTWARE FOR THE CROMCO 1K BITE-SAVES BOARD - PERMISSION AND COURTESY OF CROMCO EDITED BY ROGER EOLSON - INTERFACE AGE, JANU- 1977, VOL.2#2.	49-TEXT 0 49-HCALF 0	5.00+0.30+1.00 INC. WITH TEXT
ARR ANIPRO	ANIS PHOTO DEVELOPMENT SOFTWARE FOR EVK SERIES PHOTOGRAPHY BRADIS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A. STEVENS - INTERFACE AGE, FEB. 1977, VOL.2#3.	41-TEXT * 0 41-HCALF * 41-PACK * 0	3.00+0.10+1.00 5.00+0.30+2.00	RRR FNOCCA	RRR OBJECT CODE OIS-ASSEMBLER BY FLOYD L. MORRIS - STANDARD VERSION HANDLES UP TO 1K LABELS & ASSIGNS SYMBOLIC NAMES. ASCII CHARACTER LIST PIN POINTS EMBEDDED TABLES. INCLUDES BOTH ASSEMBLY AND SOURCE OUTPUT MODES VIA YOUR OUTPUT DRIVERS. PROGRAM RESIDES AT TOP OF MEMORY. STANDARD VERSIONS AVAILABLE FOR 160, 300, 32K, 48K AND 64K BYTES OF MEMORY. OTHER VERSIONS WITH ADDITIONAL LABEL SPACE AND/OR DIFFERENT MEMORY SIZE ARE AVAILABLE.	50-PTD 0 50-NM 0 50-PACK 0	40.00+2.40+2.00 5.00+0.30+1.00 45.00+2.70+3.00
RRR CONSOL	CONSOL 1K RESIDENT OPERATING SYSTEM BY PERMISSION AND COURTESY OF PROCCSON TECHNOLOGY - INTERFACE AGE, JUNE 1977, VOL.2#2.	42-TEXT * 0 42-HCALF * 42-PACK * 0	3.00+0.10+1.00 5.00+0.30+2.00	RRR SUTMR	SUTP'S ARRB MICROBASIC VER. 1.4 BY ROBERT H. UTERANK AND BY PERMISSION & COURTESY OF SOUTHWEST TECHNICAL PRODUCTS COMP. SUTP'S ARRB COMPUTER NEWSLETTER #1 - JUNE 1976.	51-PTD 0 51-NM 0 51-PACK 0	15.00+0.90+2.00
RRR OOT-RR	LLL BASIC OCTAL DEBUGGING PROGRAM BY E. R. FISHER - INTERFACE AGE, MARCH 1977, VOL.2#4.	43-TEXT * 0 43-HCALF * 43-PACK * 0	3.00+0.10+2.00 5.00+0.30+2.00	RRR EUMH	SUTP'S ARRB MICROBASIC VER. 1.4 MODIFIED FOR AMI'S ARRB EVK MICROCOMPUTER BOARDS BY STEVEN G. VALL.	52-PTD 0 52-NM 0 52-PACK 0	15.00+0.90+2.00
ARR EK511	HCISOPHT ARRB REENTHANT "RELATIVE SUBROUTINE" PACKAGE FOR EVK ARRB MICROCOMPUTER BOARDS BY PERMISSION AND COURTESY OF AMERICAN MICROSYSTEMS EDITED BY R.A. STEVENS - INTERFACE AGE, MARCH 1977, VOL.2#4.	44-TEXT * 0 44-HCALF * 44-PACK * 0	3.00+0.10+1.00 5.00+0.30+2.00	RRR CCOHEN	ARTIFICIAL INTELLIGENCE TIC-TAC-TOE PROGRAM FOR MENACE OF THE MICROBOL BY NEW BERNUM - INTERFACE AGE, MARCH 1977, VOL.2#4.	53-PTD 0 53-TEXT 0 53-HCALF 0 53-NM 0 53-PACK 0	10.00+0.60+0.00 0.00+0.12+1.00 INC. WITH PTBL 2.00+0.12+1.00
ARR EK50H	ARRB MICROBASIC EXTENDED MONITOR SYSTEM BY MICHAEL BIRNBAUM - INTERFACE AGE, APRIL 1977, VOL.2#5.	45-TEXT * 0 45-HCALF * 45-PTL 0 45-PTD 0 45-PACK * 0	2.00+0.10+1.00 3.00+0.10+1.50 9.00+0.50+0.00 5.00+0.30+2.00	RRR JNDTWP	DAY OF THE WEEK PROGRAM BY JIM HUFFMAN -	54-PTD 0 54-TEXT 0 54-HCALF 0 54-NM 0 54-PACK 0	6.00+0.30+1.00 1.00+0.00+1.00 INC. WITH PTBL 1.00+0.00+1.00
RRR LNCDS	ARRB CASSETTE OPERATING SYSTEM (COS) BY LOREN MOLLEN - INTERFACE AGE, APRIL 1977, VOL.2#5.	46-PTD 0 46-PTL 0 46-HCALF * 46-PACK * 0	3.00+0.10+1.00 10.00+0.60+0.00 5.00+0.30+1.00	RRR JNCBIP	CHECKBOOK BALANCER PROGRAM BY JIM HUFFMAN -	55-PTD 0 55-TEXT 0 55-HCALF 0 55-NM 0 55-PACK 0	6.00+0.30+1.00 1.00+0.00+1.00 INC. WITH PTBL 1.00+0.00+1.00
ARR MHFIFNC	MOTOBOLA ARRB HPX FORMAT TO INTEL FORMAT SOFTWARE CONVERTER BY FLOYD MORRIS -	47-TEXT * 0 47-PTL 0 47-PTD 0 47-HCALF * 47-PTD 0 47-HCALF * 47-PACK * 0	1.00+0.00+1.00 2.00+0.10+0.00 5.00+0.30+2.00 3.00+0.10+1.00 3.00+0.10+1.00 INC. WITH HCAL				

LSI 11/03

COMPAL-80

CMS

ADM III

TELRAY  
3700

ALTAIR

IMSAI

Presents  
Repair of

DEC LA 36

ALTAIR

DIABLO

EXTEL

CENTRONICS

ICOM

SILENT 700

Computer Machine Service is ready to supply full service contracts on a variety of microprocessors and associated equipment. CMS is currently responsible for repair on over half-a-million dollars worth of computer equipment with the State of California Colleges and Universities.

**MICROPROCESSORS:** Full service contracts at LOW rates and time and materials service available.

**EQUIPMENT:**

ALTAIR IMSAI  
LSI 11/03 COMPAL-80  
and the list goes on.

**PERIPHERALS or  
DATA COMMUNICATIONS**

**EQUIPMENT:** Full service contracts and Board Repair available on TELRAY CRT'S, ADM III, LA 36 DE (DEC WRITER), IMSAI, ALTAIR, COMPAL-80, EXTEL PRINTERS, etc. . . .

If you have a hardware problem then CMS is the one to call. (213) 374-8118



# Computer Machine Service

2109 Pullman Lane, Redondo Beach, CA 90278

8080 HFDUMP	INTEL HEX FORMAT PAPER TAPE DUMP PROGRAM BY ALAN H. MILLER *	56-PTAL < 8 56-PTSL < 8 56-PTDS < 8 56-HCAL < 8 56-HCAL < 8 56-HCAL < 8 56-HCAL < 8 56-PACK < 8	8.000+8.48+2.00 8.000+8.48+2.00 5.000+8.30+1.00 INC. WITH PTAL 2.000+8.12+1.00 INC. WITH PTSL 2.000+8.12+1.00 56-PACK < 8	8080 HENTFST	A HETTER 8080 MEMORY TEST BY ED KFHIT *	80-PTAL < 8 80-PTSL < 8 80-PTDS < 8 80-TEXT < 8 80-HCAL < 8 80-HCAL < 8 80-HCAL < 8 80-PACK < 8	8.000+8.48+2.00 8.000+8.48+2.00 5.000+8.30+1.00 INC. WITH PTAL 2.000+8.12+1.00 INC. WITH PTSL 2.000+8.12+1.00 80-PACK < 8
8080 CONVERT1	NUMBER BASE CONVERSION- NON DISC VERSION BY JOHN V. SUAIN *	57-PTAL < 8 57-TEXT < 8 57-HCAL < 8 57-HCAL < 8 57-PACK < 8	7.000+8.42+1.00 2.000+8.12+1.00 INC. WITH PTAL INC. WITH PTSL 1.000+8.12+1.00	8080 ANLIF	JOHN CONWAY'S NAME OF LIFE PROGRAMMED BY ALAN H. MILLER *	81-PTAL < 4 81-PTSL < 4 81-PTDS < 4 81-TEXT < 4 81-HCAL < 4 81-HCAL < 4 81-HCAL < 4 81-PACK < 4	15.000+8.40+2.00 16.000+8.48+2.00 5.000+8.30+1.00 INC. WITH PTAL INC. WITH PTSL 2.000+8.12+1.00 2.000+8.12+1.00 81-PACK < 4
8080 CONVERT2	NUMBER BASE CONVERSION- DISC BASED VERSION OF CONVERT1 ABOVE BY JOHN V. SUAIN *	58-PTAL < 8 58-TEXT < 8 58-HCAL < 8 58-HCAL < 8 58-PACK < 8	7.000+8.42+1.00 2.000+8.12+1.00 INC. WITH PTAL INC. WITH PTSL 1.000+8.12+1.00	8080 SFSL	STAY LAMPS PROGRAM BY STEVEN FAHR *	82-PTAL < 8 82-PTSL < 8 82-PTDS < 8 82-TEXT < 8 82-HCAL < 8 82-HCAL < 8 82-HCAL < 8 82-PACK < 8	15.000+8.40+2.00 16.000+8.48+2.00 5.000+8.30+1.00 INC. WITH PTAL INC. WITH PTSL 2.000+8.12+1.00 2.000+8.12+1.00 82-PACK < 8

## Development Software

## • 8080 DIS-ASSEMBLER

Two Pass: Converts machine language code to assembly code. Uncovers ASCII tables. Generates up to 12K labels. Prints out symbol table. Address offset print output.

## Development Software

## 8080 DIS-ASSEMBLER

- Two Pass
- Converts machine language code to assembly code
- Uncovers ASCII tables
- Generates up to 12K labels (1K standard)
- Prints out symbol table
- Address offset print output
- Source code output
- Object code in Intel's punched paper tape format @ 40.00 + 2.40 Calif. sales tax + 2.00 postage. Manual @ 5.00 + 3.00 Calif. sales tax + 1.50 postage.

## ESP-1 SOFTWARE DEVELOPMENT OPERATING SYSTEM

Powerful 8080 Assembler-Monitor-Text Editor

\$30.00 + 1.80 Calif. sales tax + 1.50 postage and handling (includes manual).

## DEALER INQUIRIES INVITED

Call or Write

## Microcomputer Software Depository

2361 E. Foothill Boulevard  
Pasadena, California 91107

(213) 449-0616



## COMPUTER COMPONENTS

5848 Sepulveda Blvd., Van Nuys, CA 91411 (213) 786-7411

10-9 Tue.-Fri.  
Closed Monday  
10-6 Sat.-Sun.

## 2nd Store Opening Soon!

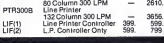
4705 Artesia Blvd., Lawndale, CA

## IMSAI PRODUCTS

## PMCE KIT ASSEM



8080 Microprocessor	699.	890.
EXP222 Motherboard	52.	—
100 Pin Connectors	5.	—
20 Card Guides	1.50	—
40 Card Guides	6.00	—
PIO & Interrupt I/O	125.	39.
GP-88 Proto Board	39.	49.
EXT. Extender Board	39.	49.
PIO-6 6 Port Parallel	164.	229.
PIO-6 3 Port Parallel	139.	180.
PIO-4 4 Port Parallel	158.	211.
PIO-4 1 Port Parallel	93.	123.
PIO Cable For PC4-41	22.	—
SIQ2-2 2 Port Serial	158.	211.
SIQ2-1 1 Port Serial	125.	175.
Cable A For SIO and MIO	18.	—
Cable C 4.5' EIA Cable	25.	—
Cable F For PC4-36	35.	—
Cable S For PC4-36	25.	—
MIO Multiple I/O	95.	295.
Cable M Cassette Recorder Cable 12	—	—
FDCC-2 Dual Floppy Drive	—	2390.
FDCC-2 Single Floppy Drive	—	1290.
FDC Drive Unit	—	599.
Floppy Controller	399.	599.
Floppy Controller Only	599.	799.
PIF2300A	—	2610.
PTF300B	—	375.
Line Printer	—	3650.
132 Column 300 LPM	—	7480.
Line Printer Controller	399.	599.
L.P. Controller Only	599.	799.



COMPUCOLOR SYSTEM	2995.
3K RAM EXPANSION	375.
SINGLE FLOPPY w/CONTROLLER	750.
DUAL FLOPPY w/CONTROLLER	1250.
LIGHT PEN	550.
DELUXE KEYBOARD	300.

## OTHER VENDORS

TARBELL Cassette Controller	120.	—
COMPUTALKER Computer Speech	—	395.
KIM-1 MOS Technology	250.	—
MULTI TERM 45 CPS PRINTER	—	2795.

## SOLID STATE MUSIC KIT ASSEM

MBSA 8K RAM	250.	300.
MBS 1702A Storage 4K	65.	—
MBS Bare Board 8K RAM	35.	—

## CROMEMCO

SOLID STATE MUSIC KIT ASSEM			
MB6A 6K RAM	250	300	
MB8 17024 Storage 4K	95		#
MB8 Bare Board 6K RAM	35		
CROMEMCO			
BYTESAVER (No EROM)	145.	215.	
BYTESAVER with EROM	195.	285.	
DAZZLER Color TV Driver	215.	315.	
D + 7A D.A. A-D Module	145.	215.	
22 Computer	595.	995.	
JS-1 Joystick	65.	95.	
WVIB Wire Wrap Board	35.	45.	



# BYTE

The Small Systems Journal

## *Isn't it time . . . you had your own personal computer?*

Read **BYTE**, the leading national publication covering the fantastic new field of personal computer applications. Today, large scale integration has made it possible for the individual to enjoy the unique benefits of a general purpose computing system. Now, an entire micro industry markets microcomputer related items, products that range from computer system kits to peripherals, software and literature on the subject. But where should you go for all the details about your personal involvement in computer technology?

Read **BYTE**, the Small Systems Journal devoted exclusively to microcomputer systems. Every issue a monthly compendium of lively articles by professionals, computer scientists, and serious amateurs.

- Detailed hardware and software design articles authored by individuals who are experimenting in the field.
- Tutorial background articles on hardware, software and applications ideas for the home computer and general topics of computer science.
- Reviews of processors as candidates for small general purpose systems.
- An editorial bias toward the fun of using and applying computers toward personally interesting problems such as electronic music, video games, control of systems for hobbies from ham radio to model railroading, uses of computers from burglar alarms to private information systems.
- Advertisements of the firms who bring you products to help expedite your personal computing activities.
- Information on clubs, newsletters and other social activities of the individuals engaged in personal computing.

Don't miss a single **BYTE**. Order your subscription today by filling in this coupon, or phone your request directly — call 603/924-7217 and ask for subscription department.

Read your first copy of **BYTE** from cover-to-cover. If it's everything you expected, honor our invoice. If it isn't, just write "CANCEL" across the invoice and send it back. You won't be billed and the first issue is yours to keep.

Allow 4 to 6 weeks for processing.

## BYTE

70 Main St., Peterborough, N.H. 03458

Please enter my subscription to **BYTE** . . .

- ☐ \$12 One Year  
☐ Bill me  
☐ Bill BankAmericard

- ☐ \$22 Two Years  
☐ Check Enclosed  
☐ \$30 Three Years  
☐ Bill Master Charge

Credit Card Number

Credit Card Expiration Date

Name (Please Print)

Address

City

State

Zip

# CONVERT MOTOROLA 6800 HEX FORMAT TO INTEL FORMAT

by Floyd Nordin

## INTRODUCTION

For those that may have EPROM programming capability on 8080 equipment such as the Intel MDS-800 or the Intellec 8/MOD 80, but do not have it on the Motorola 6800 Exerciser, the following convert program will be of interest. This program is run on the 8080 equipment. It accepts characters from an input reader device such as a paper tape reader, TTY reader, or iCOM floppy. The file or tape that is read is expected to be in the Motorola hex object code format. (This format is different from Intel's and therefore can not be loaded into 8080 RAM directly.) This program then proceeds to read the Motorola format and converts it to the Intel hex format. It sends the characters to a punch device such as a paper tape punch, TTY punch, or iCOM floppy.

## 6800 HEX FORMAT TO INTEL'S FORMAT

Because iCOM's floppy directory and format is the same for both Intel 8080 (FDOS II) and Motorola 6800 (EDOS II) equipment, it is feasible to read a Motorola floppy with the Intel equipment. The steps one would take are the following. Plug the iCOM floppy into the Intel equipment. Insert an Intel FDOS II floppy to drive 0 which has the convert program object file on it. Insert a Motorola floppy in drive 1 which contains a Motorola formatted object file, which needs to be programmed into EPROMs. After calling up FDOS II give the command: RUNGO,CNVT,MOTFILE:1,INTELFIL

## EPROM PROGRAMMING

A few seconds later the job is complete and one may now load the new converted file into RAM using the "RUN" command. Now one can get down to the business of programming the EPROMs.

Note that one can patch the program to contain different jump addresses to the reader input driver and/or punch output driver to obtain different I/O combinations.

## ASSEMBLY PROGRAM LISTING

```

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
1001
1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
1018
1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
1083
1084
1085
1086
1087
1088
1089
1090
1091
1092
1093
1094
1095
1096
1097
1098
1099
1100
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
1143
1144
1145
1146
1147
1148
1149
1150
1151
1152
1153
1154
1155
1156
1157
1158
1159
1160
1161
1162
1163
1164
1165
1166
1167
1168
1169
1170
1171
1172
1173
1174
1175
1176
1177
1178
1179
1180
1181
1182
1183
1184
1185
1186
1187
1188
1189
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210
1211
1212
1213
1214
1215
1216
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
1228
1229
1230
1231
1232
1233
1234
1235
1236
1237
1238
1239
1240
1241
1242
1243
1244
1245
1246
1247
1248
1249
1250
1251
1252
1253
1254
1255
1256
1257
1258
1259
1260
1261
1262
1263
1264
1265
1266
1267
1268
1269
1270
1271
1272
1273
1274
1275
1276
1277
1278
1279
1280
1281
1282
1283
1284
1285
1286
1287
1288
1289
1290
1291
1292
1293
1294
1295
1296
1297
1298
1299
1300
1301
1302
1303
1304
1305
1306
1307
1308
1309
1310
1311
1312
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
1325
1326
1327
1328
1329
1330
1331
1332
1333
1334
1335
1336
1337
1338
1339
1340
1341
1342
1343
1344
1345
1346
1347
1348
1349
1350
1351
1352
1353
1354
1355
1356
1357
1358
1359
1360
1361
1362
1363
1364
1365
1366
1367
1368
1369
1370
1371
1372
1373
1374
1375
1376
1377
1378
1379
1380
1381
1382
1383
1384
1385
1386
1387
1388
1389
1390
1391
1392
1393
1394
1395
1396
1397
1398
1399
1400
1401
1402
1403
1404
1405
1406
1407
1408
1409
1410
1411
1412
1413
1414
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
1426
1427
1428
1429
1430
1431
1432
1433
1434
1435
1436
1437
1438
1439
1440
1441
1442
1443
1444
1445
1446
1447
1448
1449
1450
1451
1452
1453
1454
1455
1456
1457
1458
1459
1460
1461
1462
1463
1464
1465
1466
1467
1468
1469
1470
1471
1472
1473
1474
1475
1476
1477
1478
1479
1480
1481
1482
1483
1484
1485
1486
1487
1488
1489
1490
1491
1492
1493
1494
1495
1496
1497
1498
1499
1500
1501
1502
1503
1504
1505
1506
1507
1508
1509
1510
1511
1512
1513
1514
1515
1516
1517
1518
1519
1520
1521
1522
1523
1524
1525
1526
1527
1528
1529
1530
1531
1532
1533
1534
1535
1536
1537
1538
1539
1540
1541
1542
1543
1544
1545
1546
1547
1548
1549
1550
1551
1552
1553
1554
1555
1556
1557
1558
1559
1560
1561
1562
1563
1564
1565
1566
1567
1568
1569
1570
1571
1572
1573
1574
1575
1576
1577
1578
1579
1580
1581
1582
1583
1584
1585
1586
1587
1588
1589
1590
1591
1592
1593
1594
1595
1596
1597
1598
1599
1600
1601
1602
1603
1604
1605
1606
1607
1608
1609
1610
1611
1612
1613
1614
1615
1616
1617
1618
1619
1620
1621
1622
1623
1624
1625
1626
1627
1628
1629
1630
1631
1632
1633
1634
1635
1636
1637
1638
1639
1640
1641
1642
1643
1644
1645
1646
1647
1648
1649
1650
1651
1652
1653
1654
1655
1656
1657
1658
1659
1660
1661
1662
1663
1664
1665
1666
1667
1668
1669
1670
1671
1672
1673
1674
1675
1676
1677
1678
1679
1680
1681
1682
1683
1684
1685
1686
1687
1688
1689
1690
1691
1692
1693
1694
1695
1696
1697
1698
1699
1700
1701
1702
1703
1704
1705
1706
1707
1708
1709
1710
1711
1712
1713
1714
1715
1716
1717
1718
1719
1720
1721
1722
1723
1724
1725
1726
1727
1728
1729
1730
1731
1732
1733
1734
1735
1736
1737
1738
1739
1740
1741
1742
1743
1744
1745
1746
1747
1748
1749
1750
1751
1752
1753
1754
1755
1756
1757
1758
1759
1760
1761
1762
1763
1764
1765
1766
1767
1768
1769
1770
1771
1772
1773
1774
1775
1776
1777
1778
1779
1780
1781
1782
1783
1784
1785
1786
1787
1788
1789
1790
1791
1792
1793
1794
1795
1796
1797
1798
1799
1800
1801
1802
1803
1804
1805
1806
1807
1808
1809
1810
1811
1812
1813
1814
1815
1816
1817
1818
1819
1820
1821
1822
1823
1824
1825
1826
1827
1828
1829
1830
1831
1832
1833
1834
1835
1836
1837
1838
1839
1840
1841
1842
1843
1844
1845
1846
1847
1848
1849
1850
1851
1852
1853
1854
1855
1856
1857
1858
1859
1860
1861
1862
1863
1864
1865
1866
1867
1868
1869
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050
2051
2052
2053
2054
2055
2056
2057
2058
2059
2060
2061
2062
2063
2064
2065
2066
2067
2068
2069
2070
2071
2072
2073
2074
2075
2076
2077
2078
2079
2080
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
2160
2161
2162
2163
2164
2165
2166
2167
2168
2169
2170
2171
2172
2173
2174
2175
2176
2177
2178
2179
2180
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
2222
2223
2224
2225
2226
2227
2228
2229
2230
2231
2232
2233
2234
2235
2236
2237
2238
2239
2240
2241
2242
2243
2244
2245
2246
2247
2248
2249
2250
2251
2252
2253
2254
2255
2256
2257
2258
2259
2260
2261
2262
2263
2264
2265
2266
2267
2268
2269
2270
2271
2272
2273
2274
2275
2276
2277
2278
2279
2280
2281
2282
2283
2284
2285
2286
2287
2288
2289
2290
2291
2292
2293
2294
2295
2296
2297
2298
2299
2300
2301
2302
2303
2304
2305
2306
2307
2308
2309
2310
2311
2312
2313
2314
2315
2316
2317
2318
2319
2320
2321
2322
2323
2324
2325
2326
2327
2328
2329
2330
2331
2332
2333
2334
2335
2336
2337
2338
2339
2340
2341
2342
2343
2344
2345
2346
2347
2348
2349
2350
2351
2352
2353
2354
2355
2356
2357
2358
2359
2360
2361
2362
2363
2364
2365
2366
2367
2368
2369
2370
2371
2372
2373
2374
2375
2376
2377
2378
2379
2380
2381
2382
2383
2384
2385
2386
2387
2388
2389
2390
2391
2392
2393
2394
2395
2396
2397
2398
2399
2400
2401
2402
2403
2404
2405
2406
2407
2408
2409
2410
2411
2412
2413
2414
2415
2416
2417
2418
2419
2420
2421
2422
2423
2424
2425
2426
2427
2428
2429
2430
2431
2432
2433
2434
2435
2436
2437
2438
2439
2440
2441
2442
2443
2444
2445
2446
2447
2448
2449
2450
2451
2452
2453
2454
2455
2456
2457
2458
2459
2460
2461
2462
2463
2464
2465
2466
2467
2468
2469
2470
2471
2472
2473
2474
2475
2476
2477
2478
2479
2480
2481
2482
2483
2484
2485
2486
2487
2488
2489
2490
2491
2492
2493
2494
2495
2496
2497
2498
2499
2500
2501
2502
2503
2504
2505
2506
2507
2508
2509
2510
2511
2512
2513
2514
2515
2516

```

```

01B9 D430      4 ASSEMBL  CHIT      'O'
01BB FE04      5 FPI      10
01BD FE      6 RM
01BE D607      7 SET      7
01BO CV        8 SET

      1
      1 CHANGE HEX IN 'A' TO ASCII INT 'C'
      2
01V1 FA0F      10 INVCSE1  AMI  08H
01V3 C690      11 ADD      90H
01V5 C7      12 MOV      00H
01V6 C140      13 ACR      40H
01V8 C7        14 MOV      00H
01V9 AF        15 RND      C.0
01VA CV        16 SET

      2
      2 WRITE A CRF
      3
01V9 C0B0      17 MCHI F1  COL1  L.00H
01V9 C0B0      18 COL1  M01
01AD C0A0      19 MOV      C.0H
01AB C0A0      20 COL1  M01
01AC CV        21 SET

      1
      1 WRITE AM INT1E FMD OF 51F RCHD & FINISH
      2
01AB C0B0      22 FINISH  COL1  M01
01AF 0A        23 MOV      7.1
01V7 C0B0      24 COL1  M01
01AL AM        25 MEA      A
01V7 C7D0      26 FMS      02D1F A
01B5 AF        27 BFC AF
01V8 C7D0      28 LAM      02D1F A
01B6 AF        29 MEA      A
01B7 C7D0      30 FMS      02D1F A
01B8 3E        31 MOV      3
01B9 C7D0      32 FMS      02D1F A
01BE 01F       33 MOV      0.01F
01C3 C7D0      34 FMS      02D1F A
01C4 C7D0      35 FMS      02D1F A
01C5 C7D0      36 FMS      02D1F A

```

```

ASCHX 018V      DATAL 014B      DATAL 014A      EXIT 0106
FINSH 01A6      HXASC 0191      RHYTE 015A      RI 0100
RICH 0151      START 0109      WBYTE 0172      WCLLF 019F
WRT 0103

```

## OBJECT PROGRAM LISTING

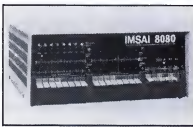
[illegible]

# WE CAN SELL YOU ONE, TOO

It seems like just about everybody and his brother can get you a deal on a name brand micro computer—IMSAI, and all the rest! We can sell you one, too.

But what happen to all of those "bargain dealers" when something goes wrong? When something doesn't work? When something just isn't there? (Sometimes it seems that some of those "bargain dealer" don't stay around long enough to pick up their mail once they've 'taken' your order.)

We are the ORANGE COUNTY  
COMPUTER CENTER, in Costa  
Mesa at 1913 Harbor Boulevard.  
We sell the names you're looking



for in micro computers, peripherals, and software—ICOM, IMSA, CROMEMCO, PROCESSOR TECH, TECHNICAL DESIGN LABS, NORTHSTAR, POLYMORPHIC, and more! But our doors are also open when you've got a problem. We can service what you have.

whether we sold it to you or not! Try getting that kind of assistance from one of those "bargain dealers".

So, be here to stop in, see our store, meet our people, and look over all the exciting things we have waiting for you inside. See our 7 foot Advent Videobeam Projection Color Terminal. Seven feet! Nobody can complain about not being able to read the video screen with this! And there are lots of other great things in store. Come on by. Or give us a call if we can help. Or you can even drop us a letter—we'll be here to get it. We're here to help.

ORANGE COUNTY

# COMPUTER CENTER

1913 HARBOR BOULEVARD

COSTA MESA, CALIFORNIA 92627

(714) 646-0221

# User TTY Handler for the Z-80 Development System

by Richard E. Maly

## INTRODUCTION

Serial is a serial I/O routine with a software UART to provide user mode communication in the Z-80 Development System. The source may be assembled at any ORG address, provided the interrupt jump table is properly adjusted (see Reassembly). The interrupt handler is from Z-80 OS5.

Serial is made up of three subroutines and an interrupt handler which uses the Z-80 mode 2 to count bit times with the counter-timer circuit.

### USING SERIAL AS PROVIDED

1. Serial will load from DEBUG starting at address 03F20H.
2. The routine is set up for 110 baud, and must be modified for other baud rates. The parameters are:

LOC	110 BAUD	300 BAUD	2400 BAUD
3FF0H	0AFH	0AFH	08FH
3FF1H	0A5H	0A5H	085H
3FF2H	04AH	01BH	036H
3FF3H	025H	0DH	01BH
3FF4H	05H	05H	06H

3. The user program must initialize the UART by a call setup, where setup EQU 03F4FH. Set up must be called each time USER MODE is entered, since the development system resets all peripherals on a break to monitor mode.
4. To output a character, the ASCII character must be in the A register. The calling sequence is:  
LD A (CHAR); CHAR is a memory LOC of the ASCII character  
CALL TTYOUT; CALL I/O driver. TTYOUT EQU 03F3BH.
5. To receive a character:  
CALL TTYIN; Get a character. TTYIN EQU 03F3BH.  
TTYIN will return with the character in the A register.
6. NOTE: TTYIN and TTYOUT save the HL register pair on the user assigned stack. The UART interrupt handler does not save registers, but instead uses the alternate register set.

If the user program uses the alternate registers, the driver should be modified or the alternate registers should be pushed on to the stack prior to calling TTYIN or TTYOUT. (see Reassembly).

7. The driver TTYOUT does not put out null characters (OOH) after a carriage return. The user should include code to output nulls on printing terminals

where required to allow time for the mechanical carriage motion. LOC 3FF4H (RTNIDL) is set up as a constant for null characters. A typical output routine with nulls is:

PRINT	LD A (CHAR)	; Get character
	CP OD	; Test for cr
JR Z NULLS		
PRINT	LD A (CHAR)	; Get character
	CP OD	; Test for cr
	JR Z NULLS	; Yes it is
	CALL TTYOUT	; No print
	RET	
NULLS	CALL TTYOUT	; Output cr
	LD A LINF	; Load a linefeed
	CALL TTYOUT	; Output LF
	LD A 00	; Load a null
	LD B RTNIDL	; Number of Nulls
MORE	CALL TTYOUT	; Loop until done
	DJNZ MORE-\$	
	RET	

## TESTING THE UART

TESTTY is a simple echo driver with a starting address of 1000H load TESTTY and serial via DEBUG. Modify the speed parameters if required, and then GO 1000.

The user may now type in a string, and when a CR is typed, the program will print (ECHO) the string.

Reassembly: if the user wishes to reassemble the handler, serial source must be edited.

1. Line 04 must be changed to the new starting address (ORG address).
2. Line 120 must be changed to relocate the interrupt jump table address (ORG INTRUP). The jump table must be loaded at an address with the last 3 bits 0 (ADD = XXX0H or XXX8H) in order to properly load the CTC interrupt vector. Therefore ORG INTRUP (line 120) should be ORGXXX0H or XXX8H where XXX0 or 8H does not interfere with the driver or the user program. One method of calculating ORG INTRUP is

$$\text{ORG Address} + \text{OC7} + \text{N}$$

Where N is the offset required to put INTRUP at XXX0H or XXX8H

3. The calling address will be:

SETUP	CALL	SERIAL + 02FH
TTYOUT	CALL	SERIAL
TTYIN	CALL	SERIAL + 01BH
SERIAL	EQU	ADDRESS

4. To change the UART from use of alternate registers to use of the main registers. It is necessary to change the code at lines 56, 57, 97, and 98 of the source. This will also change the address of INTRUP.

A. Delete Lines 56, 57, and replace with:

PUSH AF  
PUSH BC  
PUSH HL

**B. Delete lines 97 and 98, and replace with:**

POP HL  
POP BC  
POP AF

This will add two bytes of code and  $ORG\ INTERUP = ORG\ Address + C9 + N$

## SERIAL PROGRAM LISTING

THIS IS A SAMPLE RUN OF THE PROGRAM SERIAL USING THE TESTTY DRIVER

```
OS>D
>LSIL SERIAL
>L TESTTY
>Q 1000
THIS IS A TEST OF THE PROGRAM SERIAL
THIS IS A TEST OF THE PROGRAM SERIAL
THIS IS A TEST OF THE AUBOUT TESTING NOW
THIS IS A TEST OF THE AUBOUT TESTING NO
THIS IS THE TEST OF THE CTRL PTESTING NOW
TESTING NOW
```

```

0001:  BIT DRIVERS FOR USE WITH SOFTWARE LA
0002:  ENTER TTYOUT HL WITH CHARACTER IN A
0003:  TTYIN EXITS WITH CHARACTER IN A
0004:  ORG 0000
0005:  TTYOUT RUSH HL
0006:  LD M, FLAG
0007:
0008:  C876
0009:  MOV TTYIT BIT TTYOUT HL
0010:  JR NZ TTYOUT HL
0011:  MOV TTYIN HL
0012:  LD A, (STCOL)
0013:  AND TTYIN HL
0014:  OUT (CL1) A
0015:  A TTYIN HL
0016:  LD TTYIN HL
0017:  SET WNT HL
0018:  ROR HL
0019:  RET
0020:
0021:  C876
0022:  MOV TTYIN HL
0023:  NOB
0024:  NOB
0025:  NOB
0026:  RUSH HL
0027:  LD M, FLAG
0028:
0029:  C876
0030:  TSTCVIT BIT PCHVCH HL
0031:  JR Z TSTCVIT HL
0032:  LD A, (CHAPT)
0033:  ROR PCHVCH HL
0034:  ROR PARITY A
0035:  ROR HL
0036:  RET
0037:
0038:  C876
0039:  SETUP FOR SOFTWARE LA
0040:  NOB
0041:  SETUP LD A, OEH
0042:  NOB
0043:  OUT (CL1) A
0044:  LD A, (OEH)
0045:  LD A, FLAG
0046:  ROR TTYIN HL
0047:  RES WNT HL
0048:  RES PCHVCH HL
0049:  LD M, 0
0050:  LD A, 0
0051:  LD A, 0
0052:  EI
0053:  CALL TTYOUT
0054:  C876
0055:

```

```

0056 FB 0054 UNMT:
3F6E D9 0056 EI
3F6E D9 0056 EX AF AP
3F70 ADEBEC3F 0058 LD BC (7F70A1)
3F74 B1E1F7 0059 LD HL, FLAG
0077 C0 0061 JAC C
3F78 75 0061 LD A,C
3F78 C8E2 0062 LD HL, IN1
3F7B 20A4 0063 JZ NC V1C7=5
3F7D FE01 0064 C 1
3F7D 200E 0065 LD MT1=4
3F81 D9F7 0066 SEC FIRST IN A (WD)
3E83 0067 LD HL, WAD-5
3E85 B977 0068 JB 1 RETURN=4
3F87 1804 0069 LD HL, RESCT-4
3F8B 0070 NOT1 C 2
3F8B 200E 0071 JB HL, DATA1=4
3F90 74E33F 0072 LD A, GETCL1=4
3F90 03F1 0073 OUT (0x1) A
3F92 34E23F 0074 LD HL, WAD-5
3F95 03F1 0075 OUT (0x1) A
3F97 C8F5 0076 LD HL, TTYIN1=4
3F9B 1823 0077 JB MTUEN1=4
3F9B 08F7 0078 DATA1 IN A (WD)
3F9B E501 0079 LD WMD01
3F9E 80 C 8
3F9E 7F00 0080 INC1
3FA3 47 0082 LD B A
3FA3 79 C C
3FA3 FE04 0083 LD C 10
3FA5 2017 0085 JB HL, RETURN=4
3FA7 78 B 8
3FA7 0087 LD (CHAM) A
3FA8 0088 LD (CHVCHAM) A

```

[illegible]

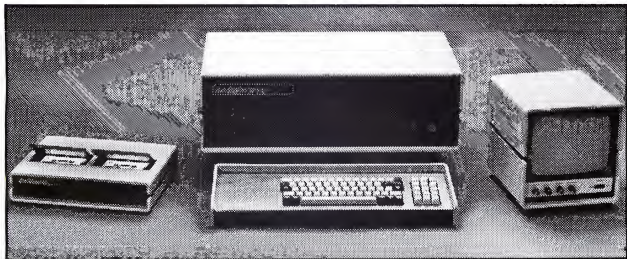
# Our Digital Group Package Plan

Completely Assembled and Ready To Run!

Unpack It. . . Plug It In . . . You're Up and Running!

No soldering — We do it for you.

No debugging — We do it for you.



**Z80 Computer with Keyboard and Video Monitor\***

—includes—

Z80 CPU

Video and Cassette Interfaces

I/O System

Memory

Power Supply & Cabinet

64 character screen

**\*everything!!**

**Z80 Package 1** With 10K Memory (fully assembled) . . . . . \$1480.00

**Z80 Package 2** With 18K Memory (fully assembled) . . . . . \$1710.00

**Z80 Package 3** With 26K Memory (fully assembled) . . . . . \$1933.00

**\*Optional Complete Software Package. . . . \$65.00**

—includes—

Z80 Extended Basic

Z80 Tiny Basic

Z80 Assembler

Z80 Disassembler

Z80 Text Editor

Star Trek

# Sunshine Computer Company

20710 South Leapwood Avenue

Carson, California 90746

(213) 327-2118

RICH TRAVIS



# Number Base Conversion Routine

by John W. Swain

## INTRODUCTION

This program was written for use on my system to facilitate the conversion of numbers in one base to another. Two versions are presented in this article:

- (1) A non disc version for interactive conversions
- (2) A disc based version which allows converting a file written in one base to another base. This is useful if your assembler output is on OCTAL and you need 'BNPF' code to work with an EPROM programmer.

## DESCRIPTION

The following programs give you the ability to convert from 'OCTAL', 'HEX', 'DECIMAL', and 'INTEL Corp. 'BNPF' code into any of the other codes.

These programs were written in Rev. 4.0 ALTAIR Extended BASIC (disc version) and may contain commands not found in other versions of BASIC.

Two of the following commands which may not appear in your version of BASIC are: (1) HEX\$(X) and (2) OCT\$(X).

The function 'HEX\$(X)' gives the hexadecimal representation of the argument 'X'. The function 'OCT\$(X)' gives the OCTAL representation of the argument 'X'.

For BASICs which don't contain these functions, the following code could be used. This is broken down into three parts:

- (1) Must be placed at the front of the program.  
 10 DATA 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F  
 20 DIM H\$(15)  
 30 FOR I = 0 TO 15  
 40 READ H\$(I)  
 50 NEXT I  
 60 RESTORE
- (2) To replace the function 'OCT\$(X)' use the following code:  
 870 FOR I1 = 5 TO 0 STEP-1  
 872 T = (C + .1) / 8 + 1  
 874 Y\$ = Y\$ + H\$(T)  
 876 C = ((T - INT(T)) \* 8 + 1) + (.5 \* 10 - 1)  
 878 NEXT I1
- (3) To replace the function 'HEX\$(X)' use the following code:  
 890 FOR I1 = 3 TO 0 STEP-1  
 892 T = C / 16 + 1  
 894 Y\$ = Y\$ + H\$(T)  
 896 C = (T - INT(T)) \* 16 + 1  
 898 NEXT I1

Note: The line numbers are just for reference and must be changed to fit into the program you are using.

There are several other functions which may not be found in other versions of BASIC, and these are listed below with a brief description of their function:

- (1) VAL\$(X) Returns the numeric value of X\$
- (2) STR\$(X) Returns a string variable of the argument 'X'. These two functions allow converting between string variables and single precision numbers.
- (3) ASC\$(X) Returns the decimal number equivalent of the ASCII character 'X\$'
- (4) IF—THEN—ELSE If the argument is true, the state-

ment following the 'THEN' is used, however, if the argument is false, the argument following the 'ELSE' is used.

Please note that with proper modification, this program could read into an array from a paper or mag tape and output, back onto the same or different media, the converted code. With a disc system, it would be simply a matter of reading a file one record at a time and writing it back onto the disc in the converted format into another file.

The two versions presented below are:

- (1) A non disc interactive program.
- (2) A disc version currently residing on my system which contains program #1 coupled with the ability to use disc files.

## PROGRAM SIZE

The size of the programs are as follows:

PROGRAM #	SOURCE	RUNNING
1	2.2 K	2.2 K
2	3.0 K	3.0 K

## AUTHOR'S COMMENTS

The author would be interested in hearing from other readers of INTERFACE AGE concerning other types of applications oriented programs which you would like to see put into the MSD.

The author would be willing to write as many of these programs as his time allows and then place them in the MSD for use by all individuals concerned.

The author has had several microprocessor systems, the latest of which is an ALTAIR 8800B, with two floppy disc drives, 60K of memory, 2K of ROM, 2 serial ports, 4 parallel ports, a VDM-1, an ASR-33, and a high speed facit paper tape punch.

Any suggestions should be submitted in writing, with a brief description of its function, and any specialized formulas which the author may not be familiar. These should be sent to Bob Stevens of the MSD. I will then review them and then act accordingly.

All used suggestions will include the name of the person suggesting the routines and the configuration required to run the program.

There are two programs which are currently in the process of being written, and which I hope to publish and to release to the MSD for distribution. These are a 2704-2708 EPROM programmer-editor (17 possible commands) and a schematic of the programmer itself, with a complete text editing system for use in writing letters and magazine articles.

Let's hear your suggestions!

## CONVERT-VERSION BASIC LISTING

```

100 REM THIS PROGRAM IS FOR CONVERSION FROM FULLER SOURCE
110 REM PROGRAM TO CONVERT FROM ONE BASE TO ANOTHER
120 REM NUMBER OF BASES = 36
130 REM
140 REM
150 REM
160 REM C = INTERMEDIATE BASE 16 INITIAL VALUE
170 REM Y$ = ANSWER IN THE POINT ABOVE FOR
180 REM X$ = INPUT VALUE TO THE BASE X TO BASE 16 INTER. CONVERSION

```



[illegible]

1310 NEXT I  
1320 RETURN

## CONVERT-NON DISC VERSION BASIC LISTING

[illegible]

DIODES/ZENERS				SOCKETS/BRIDGES				TRANSISTORS, LEDS, etc.			
1N914	100v	10mA	.05	8-pin pcb	.25	ww	.45	2N2222	NPN		.15
1N4004	400v	1A	.08	14-pin pcb	.25	ww	.40	2N2907	PNP		.15
1N4005	600v	1A	.08	16-pin pcb	.25	ww	.40	2N3740	PNP 1A	60v	.25
1N4007	1000v	1A	.15	18-pin pcb	.25	ww	.75	2N3906	PNP		.10
1N4148	75v	10mA	.03	22-pin pcb	.45	ww	1.25	2N3054	NPN		.35
1N753A	6.2v	z	.25	24-pin pcb	.35	ww	1.25	2N3055	PNP 15A	60v	.50
1N758A	10v	z	.25	28-pin pcb	.35	ww	1.45	T1P125	PNP Darlington		.35
1N759A	12v	z	.25	40-pin pcb	.50	ww	1.95	LED Green, Red, Clear			.15
1N4733	5.1v	z	.25	Molex pins .01	To-3	Sockets	.25	D.L.747	7 seg 5/8" high com-anode		1.95
1N5243	13v	z	.25	2 Amp Bridge	100-prv		1.20	XAN72	7 seg com-anode		1.50
1N5244B	14v	z	.25	25 Amp Bridge	200-prv		1.95	FND 359	Red 7 seg com-cathode		1.25
1N5245B	15v	z	.25					HP276	com-cathode		1.25

C MOS				T T L							
4000	.15	7400	.15	7473	.25	74176	1.25	74H72	.55	74S133	.45
4001	.20	7401	.15	7474	.35	74180	.85	74H101	.75	74S140	.75
4002	.20	7402	.20	7475	.35	74181	2.75	74H103	.75	74S151	.35
4004	3.95	7403	.20	7476	.30	74182	.95	74H106	.95	74S153	.35
4006	1.20	7404	.15	7480	.55	74190	1.75			74S157	.80
4007	.35	7405	.25	7481	.75	74191	.35			74S158	.35
4008	1.20	7406	.35	7483	.95	74192	1.65	74L00	.35	74S194	1.05
4009	.30	7407	.55	7485	.95	74193	.85	74L02	.35	74S257 (8123)	.25
4010	.45	7408	.25	7486	.30	74194	1.25	74L03	.30		
4011	.20	7409	.15	7489	1.35	74195	.95	74L04	.35		
4012	.20	7410	.10	7490	.55	74196	1.25	74L10	.35	74LS00	.45
4013	.40	7411	.25	7491	.95	74197	1.25	74L20	.35	74LS01	.45
4014	1.10	7412	.30	7492	.95	74198	2.35	74L30	.45	74LS02	.45
4015	.95	7413	.45	7493	.40	74221	1.00	74L47	1.95	74LS04	.45
4016	.35	7414	1.10	7494	1.25	74367	.85	74L51	.45	74LS05	.55
4017	1.10	7415	.25	7495	.60			74L55	.65	74LS08	.45
4018	1.10	7417	.40	7496	.80			74L72	.45	74LS09	.45
4019	.70	7420	.15			75108A	.35	74L73	.40	74LS10	.45
4020	.85	7426	.30			75110	.35	74L74	.45	74LS11	.45
4021	1.35	7427	.45	74100	1.85	75491	.50	74L75	.55	74LS20	.40
4022	.95	7430	.15	74107	.35	75492	.50	74L93	.55	74LS21	.25
4023	.25	7432	.30	74121	.35			74L123	.55	74LS22	.25
4024	.75	7437	.35	74122	.55					74LS32	.40
4025	.35	7438	.35	74123	.55	74H00	.25			74LS37	.40
4026	1.95	7440	.25	74125	.45	74H01	.25	74S00	.55	74LS40	.55
4027	.50	7441	1.15	74126	.35	74H04	.25	74S02	.55	74LS42	1.75
4028	.95	7442	.55	74132	1.35	74H05	.25	74S03	.40	74LS51	.65
4030	.35	7443	.85	74141	1.00	74H08	.35	74S04	.35	74LS74	.75
4033	1.95	7444	.45	74150	1.00	74H10	.35	74S05	.35	74LS86	.75
4034	2.45	7445	.80	74151	.75	74H11	.25	74S08	.35	74LS90	1.30
4035	1.25	7446	.95	74153	.95	74H15	.30	74S10	.35	74LS93	1.00
4040	1.35	7447	.95	74154	.75	74H20	.30	74S11	.35	74LS107	.95
4041	.69	7448	.95	74156	1.15	74H21	.25	74S20	.35	74LS123	1.00
4042	.95	7450	.25	74157	.65	74H22	.40	74S40	.25	74LS151	.75
4043	1.25	7451	.25	74161	.85	74H30	.25	74S50	.25	74LS153	1.20
4044	.95	7453	.20	74163	.95	74H40	.25	74S51	.45	74LS157	.85
4046	1.50	7454	.25	74164	.60	74H50	.25	74S64	.25	74LS164	1.90
4049	.80	7460	.40	74165	1.50	74H51	.25	74S74	.40	74LS367	.85
4050	.60	7470	.45	74166	1.35	74H52	.15	74S112	.90	74LS368	.70
4066	1.35	7472	.45	74175	.80	74H53J	.25	74S114	1.30		
4069	.40					74H55	.25				
4071	.35										
4082	.45										

9000 SERIES				LINEARS, REGULATORS, etc.					
9301	.85	8266	.35	LM320K5	1.65	LM340T-24	.95	LM723	.45
9309	.35	8836	.95	LM320K12	1.65	LM340K-12	2.15	LM725	1.75
9322	.85	MCT2	.95	LM320T12	1.25	LM340K-15	1.25	LM739	1.50
95H03	.85	8038	3.95	LM320T15	1.65	LM340K-18	1.25	LM741 8-14	.20
9601	.75	LM201	.75	LM339	.95	LM340K-24	.95	LM747	1.10
9602	.50	LM301	.25	7805 (340T-5)	.95	LM373	2.95	LM1307	1.25
		LM308 (Mini)	.75	LM340T-12	1.00	LM380	.95	LM1458	.95
		LM309H	.65	LM340T-15	1.00	LM709(8,14 PIN)	.25	LM3900	.50
		LM309K(340K-5)	.85	LM340T-18	1.00	LM711	.45	LM75451	.65
		LM310	1.15					NE555	.50
		LM311D(Mini)	.75					NE556	.95
		LM318 (Mini)	.65					NE566	.95

MEMORY CLOCKS			
74S188 (8223)	3.00		
1702A	7.95		
MM5314	3.00		
MM5316	3.50		
2102-1	1.75		
2102L-1	1.95		
TM56011NC	6.95		
8080AD	15.00		
8T13	1.50		
8T23	1.50		
8T24	2.00		
2107B-4	4.95		

INTEGRATED CIRCUITS UNLIMITED			
7889 Clairemont Mesa Blvd. San Diego, CA 92111 (714) 278-4394			
All orders shipped prepaid		No minimum	
Open accounts invited		COD orders accepted	
Discounts available at OEM Quantities			
California Residents add 6% Sales Tax			
24 Hour Phone (714) 278-4394		MasterCharge / BankAmericard	

LM723	.45	LM725	1.75
LM739	1.50	LM741 8-14	.20
LM747	1.10	LM1307	1.25
LM1458	.95	LM1459	.50
LM3900	.50	LM75451	.65
NE555	.50	NE556	.95
NE566	.95	NE566	.95
NE566	1.75	NE567	1.35
SN72720	1.35	SN72820	1.35

# SC/MP SEIKO PRINTER INTERFACE AND PROGRAM — SSEIKOPP

by Philip Roybal

## INTRODUCTION

The computer hobbyist who sets up his first home system with somebody's microprocessor and a "glass teletype" discovers a serious limitation when he starts writing programs, or more precisely, when he starts debugging them. He finds that the typical video interface provides storage for about only 32 lines of display, 1/2 of which are usually visible at one time. Therefore, in *debug* mode he either spends much time writing things down or else he develops a good memory for subroutine entry points, tables of contents, etc. Eventually he feels the need for hard copy and a printer to produce it. This article discusses the hardware and software used to interface a low-cost Seiko printer with National Semiconductor's SC/MP microprocessor.

## FEATURES OF SEIKO 310 PRINTER

The Model 310 Seiko Digital Printer (made by Shinshu Seiki Co., Ltd. of Japan) was chosen for this application because it is compact and readily available. In addition, it provides at low cost a handy set of features including:

- Single supply voltage (17V)
- Speed of 2-5 lines/second
- Choice of two print colors
- 16-column print format.

The printer mechanism consists of 16 12-character print wheels (figure 1) driven through individual clutches by a common shaft.

When a print command is sent to the printer, the wheels begin to rotate and a timing pulse ( $T_0, T_1, T_2 \dots T_{11}$ ) is generated for each character position of the wheels (figure 2). During the  $T_0$  to  $T_8$  interval, color information is transmitted to select the color of tape to be printed. When the position of a wheel corresponds to the selected

symbol for that column, the print wheel is stopped and mechanically latched; thus, at the trailing edge of timing pulse  $T_{11}$ , all the print wheels are locked in position. When the platen print signal goes high, the selected characters for each column are transferred to the paper; then the paper is advanced. After completion of the print cycle, the motor drive signal is terminated and each print wheel returns to the initial blank (B) position.

## INTERFACE HARDWARE

The SC/MP-to-printer interface (figure 3) is implemented via a special-purpose chip set that includes interface logic No. 1 (DS8693), interface logic No. 2 (DS8694), and two transistor arrays (DS8692). The DS8693 device contains the interface logic for the color solenoid driver, the motor driver, and seven of the column/character select solenoid drivers; the DS8694 chip contains the interface logic for eight column/character solenoid drivers plus the clock oscillator and timing-signal buffer. Each transistor array contains eight common-emitter output circuits. Each circuit features active pull down and each can sink up to 350 milliamperes of current.

Address decoding for the printer interface is performed by a BCD-to-decimal decoder (DM74LS138). Hexadecimal address X'0200 is assigned to access the printer; address assignments for interface control are as follows:

HEX ADDRESS	FUNCTION	REMARKS
0200	Printer Interface	
0201	Clock IN1	Used to load DS-8693 with print information for columns D10 through D16
0202	Clock IN2	Used to load DS-

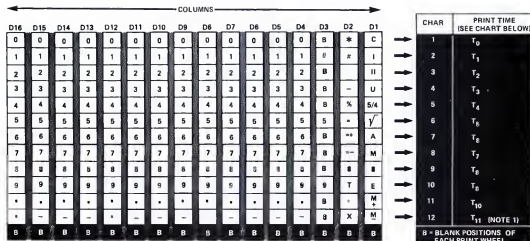


Figure 1.

The 16 12-character print wheels of the Seiko printer, with the timing pulse corresponding to each character.

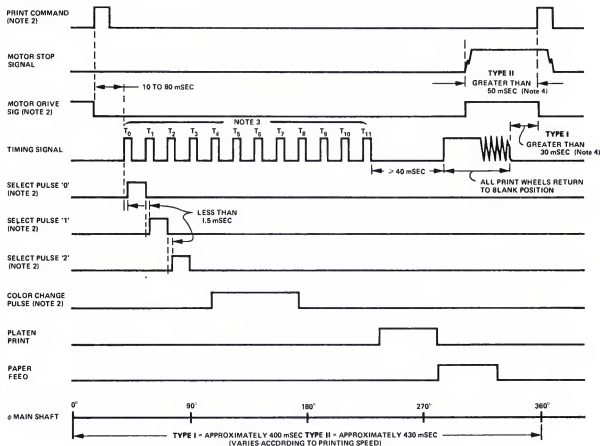
8694 with print information for columns D1 through D9

0203 Common Clock Used to clear DS-8693 and DS8694

0204 Print Used to issue PRINT COMMAND

In operation, the SC/MP CPU executes a STORE command to Hex address X'0204, causing a PRINT

signal to be sent to the Seiko printer. It then monitors Sense A, checking for the presence of a timing pulse. As the print wheels start turning and timing pulses are generated by the printer, the SC/MP compares information in the data buffer (X'0100—X'010F) against the code list for each column to determine what (if any) print wheels are to be stopped and latched at that print position. Then, shortly after the start of each timing pulse, the SC/MP will output two bytes of data through addresses X'0201 and X'0202. These bytes will contain zeros in bit positions corresponding to each

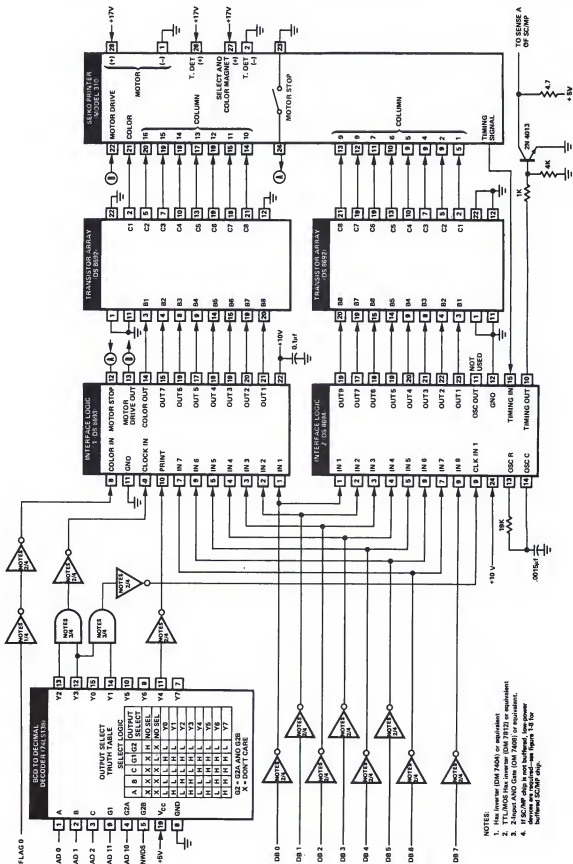


## NOTES:

1. Printed "Red" in columns D4 through D16 to represent negative result.
2. These signals are generated by SC/MP.
3. Time period between T<sub>0</sub> and T<sub>11</sub> = 13 to 25 mSEC.
4. For a "Type I" timing cycle, implement a 30-millisecond delay between last trailing edge of "Return" signal and leading edge of "Print" command; for a "Type II" timing signal, implement a 50-millisecond delay between leading edge of "Motor Stop" signal and leading edge of "Print" command.
5. For further detail on Model 310 DIGITAL PRINTER, refer to specification sheets and other documents of manufacturer (Shimadzu Seiki Co., Ltd. of Japan); for further detail on devices DM 8693 and DM 8694, refer to specification sheets of National Semi-conductor Corp.

Figure 2. These are the timing pulses that occur during a print cycle of the Seiko printer interface.





**Figure 3. The SC/MP to Seiko Printer Interface.**

print wheel to be latched at that time (figure 4). From this information, the DS8693/DS8694 logic elements generate select pulses for the printer.

(NOTE: The TTL-to-MOS inverters in the interface devices require that the column drivers be driven with a logic '0' for selection; that is, the print wheels lock into position at a particular timing pulse if the COLWORD bit corresponding to that position is a logic '0'.)

After the print wheel shaft has rotated through all twelve print positions and all print wheels are latched, the printer prints the line, advances the paper, and resets all print wheels. The SC/MP resets the interface elements, and is then ready to print the next line.

## INTERFACE SOFTWARE

The printer program utilizes a data buffer that is maintained in RAM (figure 5). This buffer is filled by any appropriate input device (keyboard, tape, or other), and the program is then executed starting at address 0000 to print a line consisting of 16 characters. As shown in figure 4, the 16 columns — each column corresponding to a print wheel — are divided into two column words: COLWORD 1 representing the characters to be printed for columns D1 through D9 (D3 is blank), and COLWORD 2 representing characters for the remaining columns (D10 through D16). The character codes for each column and the constants used to select a particular column are stored in ROM. When the characters stored in the data buffer for a particular column agree with those in the character code list, the print wheel for that column is mechanically latched; thus, at the end of the timing cycle ( $T_0 \dots T_{11}$ ), all 16 print wheels are locked in position and the line is printed.

# TECH-MART

Unique in Offering Full Service

- Media Supplies
- Peripheral Products
- Components
- Assembled Systems
- Kits
- Software Development Facilities
- Developed Software Packages
- Work Benches
- Cross Assemblies & Fortran Cross Compilers
- Hardware & Software Classes

For the Hobbyist or for  
Development of Commercial Applications—  
**Tech-Mart** offers full support.

We are the S.F.V. Dealer for:

**Alpha Microsystems**

And Distributor for:

**Electronic Tool Company**

## TECH-MART

19590 Ventura Boulevard, Tarzana, CA 91356  
(213) 344-0153

CIRCLE INQUIRY NO. 86

COLUMNS	→	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1
CHARACTER	→	9	8	7	6	5	4	3	2	1	0	.	6	6	--	*	M
COLWORD 2									COLWORD 1								
BITS									BITS								
		8	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
T <sub>0</sub>	→	1	1	1	1	1	1	1	1	1	0	1	1	1	--	0	1
T <sub>1</sub>	→	1	1	1	1	1	1	1	1	0	1	1	1	1	--	1	1
T <sub>2</sub>	→	1	1	1	1	1	1	1	0	1	1	1	1	1	--	1	1
T <sub>3</sub>	→	1	1	1	1	1	1	0	1	1	1	1	1	1	--	1	1
T <sub>4</sub>	→	1	1	1	1	1	0	1	1	1	1	1	1	1	--	1	1
T <sub>5</sub>	→	1	1	1	1	0	1	1	1	1	1	1	1	1	--	1	1
T <sub>6</sub>	→	1	1	1	0	1	1	1	1	1	1	1	0	0	--	1	1
T <sub>7</sub>	→	1	1	0	1	1	1	1	1	1	1	1	1	1	--	1	1
T <sub>8</sub>	→	1	0	1	1	1	1	1	1	1	1	1	1	1	--	1	1
T <sub>9</sub>	→	0	1	1	1	1	1	1	1	1	1	1	1	1	--	1	1
T <sub>10</sub>	→	1	1	1	1	1	1	1	1	1	1	0	1	1	--	1	1
T <sub>11</sub>	→	1	1	1	1	1	1	1	1	1	1	1	1	1	--	1	0

Figure 4. When the print wheels are turning, a zero level sent to a wheel's control line will latch it. This figure shows the twelve pairs of COLWORDS that are sent to the printer interface during a print cycle.

## RAM BOARD SALE

Buy 4 Kits get 8 slot mother board free

### 4K Low Power Static RAM Board

Kit \$79.95

FULL HIGH IMPEDENCE BUFFERING • 4.5" x 6" WITH STD 44 PIN GOLD-PLATED EDGE CONNECTOR • MILITARY QUALITY PC BOARD WITH PLATED THROUGH HOLES • 450 NS. LOW POWER 2102 RAMS • ON-BOARD ADDRESS DECODING INCLUDES FULL DOCUMENTATION

### 6800 OEM Prototype Sets

**PROTOTYPE BOARD** (With Sockets)

See September issue, p. 72 for details.

**42.50**

**LOW COST 6800 STARTER SET**

Includes board, sockets, 6800 CPU, 6810 RAM, 6820 PIA, address decoder, documentation for minimum system.

**84.95**

**NEW 1K RAMS** at Surplus Prices

Check Date Codes and Compare

**2102-1 1.45**

**UNGAR:** 50T7 Station

Reg. 41.67 Now 35.00

**CONTINENTAL SPECIALTIES CORP:**

Experimenter 300

Reg. 9.95 Now 8.00

Logic Monitor I

Reg. 84.95 Now 68.00

DISCOUNTS AVAILABLE AT OEM QUANTITIES

**KATHRYN ATWOOD ENTERPRISES**

P.O. BOX 5203  
ORANGE, CA 92667

• Calif. Residents add 6 sales tax  
• For total orders less than \$25.00 add \$1.25 shipping and handling  
Estimated shipping time 7 days ARO

CIRCLE INQUIRY NO. 89

## THE NEW

**BYTE SHOP** OF  
the affordable computer store **MIAMI**

7825 BIRD ROAD

(305) 264-2983

MIAMI, FL

DIAL 264-BYTE

33155

#1 IN SOUTH FLORIDA

Microcomputer kits, tools, computer system, books, hobby magazines, software (programs), expert advice, repairs, parts, chips, etc. All kits guaranteed. For hobby, business, office, schools or profession.

Join our classes and workshops-whether a beginner or an expert. Come in and browse or play real computer games. Let us show you how to use the new microcomputers for any application. Computer club information.

**SPECIALIZING IN SYSTEMS**

**OPEN: 10-6 Daily & Sat.  
10-9 Thur.**

CIRCLE INQUIRY NO. 69

## SOFTWARE SECTION

MEMORY ALLOCATIONS	
PRINTER PROGRAM	
0000	00AC
NOT USED	
00AD	00BF
COLUMN 1 CODE LIST	
00C0	00CF
COLUMN 2 CODE LIST	
00D0	00DF
COLUMNS 4-16 CODE LIST	
00E0	00EF
COLWORD CONSTANTS ADRS 00F0-00FF	
FE	
FD	
FB	
F7	
EF	
DF	
BF	
7F	
FE	
FD	
FB	
F7	
EF	
DF	
BF	
7F	
DATA BUFFER	
0100	010F
TEMPORARY STORAGE 0110-011F	
TEMP 1	
TEMP 2	
CLK CTR	
COLWORD 1	
COLWORD 2	

ROM

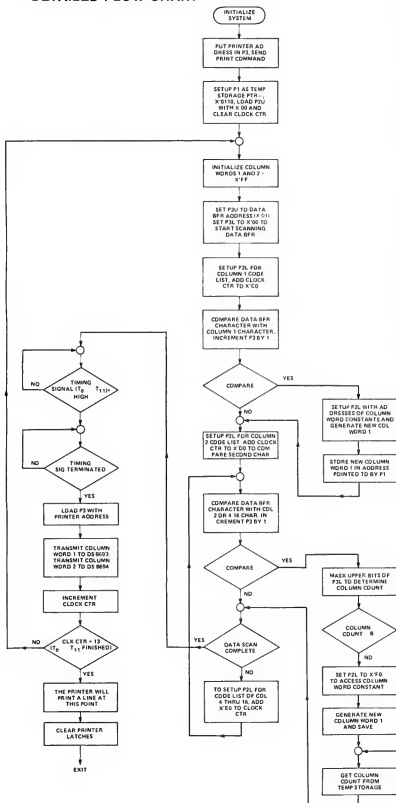
RAM\*

\*REMAINING RAM LOCATIONS ARE UNUSED.

Figure 5. Memory Allocation for Seiko Interface.

## PROGRAM FLOW DIAGRAM

## DETAILED FLOW CHART



## SUMMARY FLOW CHART

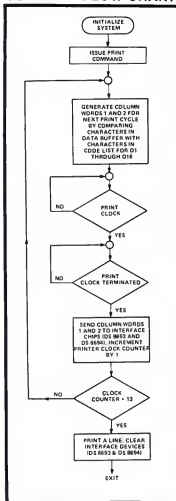


Figure 6. Seiko Printer Interface Firmware Flowcharts.

## PROGRAM ASSEMBLY LISTING

```

1      TITLE      SCHM. 'SEIYO PRINTER PRGM'
2
3      0001 P1      = 1
4      0002 P2      = 2
5      0003 P3      = 3
6      0004 CLM1    = 1
7      0005 CLM2    = 2
8      0006 CLM3    = 3
9      0007 CLM4    = 4
10     0008 SEI0    = 0200
11     0009 TEMP1    = 1
12     0010 TEMP2    = 2
13     0011 CLCTR    = 4
14     0012 CLM1     = 5
15     0013 CLM2     = 6
16
17     0000 09      NOP
18     0001 C400    PINT LD1 L'(SEI0) ; SET UP POINTER ADPS
19     0002 33      SPAL P3
20     0003 C402    LD1 H'(SEI0)
21     0004 27      SPAN P3 ; START PRINTER
22     0005 C004    ST P3 ; SET UP HIGHER MEMORY
23     0006 C401    LD1 1
24     0007 35      SPAN P1
25     0008 C400    LD1 0
26     0009 26      SPAN P2
27     0010 C410    LD1 010
28     0011 31      SPAL P1 ; SET UP TEMP STORAGE
29     0012 C400    LD1 0
30     0013 C004    ST CLCTR(P1) ; CLR CLK' COUNTER
31
32     0014 CAFF     CONTRP LD1 OFF
33     0015 C005     ST CLM1(P1) ; CLR CLK WORD1
34     0016 C306     ST CLM2(P1) ; CLR CLK WORD2
35     0017 C401     LD1 1 ; SET UP DATA BFR ADPS
36     0018 27      SPAN P3
37     0019 C400     LD1 0
38     0020 33      SPAL P2
39     0021 C104     LD CLCTR(P1) ; SET UP POINTER FOR
40     0022 F4C0     RD1 000 ; COL1 CODE LIST
41     0023 32      SPAL P2
42     0024 C701     LD 01(P3) ; BEGIN SCAN FOR DATA
43     0025 E200     XOR (P2)
44     0026 3027     JZ C00F1 ; CLM1(P1)
45     0027 C104     FETCHP LD CLCTR(P1) ; SET UP POINTER FOR C
46
47     0028 F400     RD1 000 ; SELECT COL2 CODE LIS
48     0029 32      SPAL P2
49     0030 C701     LD 01(P3) ; NO PRINTING IN COL2
50     0031 E200     CONTRON XOR (P2) ; CHECK IF DATA CODE L
51     0032 3027     JZ C00F2
52     0033 33      SPAL P3
53     0034 C301     ST TEMP1(P1)
54     0035 C40F     SCHNCK ANI 0F ; MASK UPPER 4 BITS OF
55     0036 E40F     SPAL SP1 ; IF
56     0037 300C     JZ TEST ; JMP TO WAIT FOR PRTR
57     0038 C101     LD TEMP1(P1) ; LD DATA BFR ADPS
58     0039 33      SPAL P3
59     0040 C104     LD CLCTR(P1) ; LD COL4 TO 16 CODE A
60     0041 F400     RD1 000
61     0042 32      SPAL P2
62     0043 C701     LD 01(P3)
63     0044 30E7     JMP CONTRON
64
65     0045 06      TEST. CSA ANI 010
66     0046 C410     LD1 010
67     0047 30F0     JZ TEST
68     0048 3033     JMP FISHSCH
69
70     0049 C4F0     CONTRP1 LD1 0F0 ; LD COL WORD CONST. A
71     0050 32      SPAL P2
72     0051 C200     LD (P2) ; COLWORD CONST TO ACU
73
74     0052 D185     AND CLM1(P1) ; GENERATE COLWORD 1
75     0053 C305     ST CLM1(P1) ; SAVE NEW COLWORD1
76     0054 30CE     JMP RETCOMP
77
78     0055 33      CONTRP2: SPAL P3
79     0056 C301     ST TEMP1(P1) ; SAVE DATA BFR ADPS
80     0057 C40F     ANI 0F ; MASK UPPER 4 BITS
81     0058 C302     ST TEMP2(P1) ; SAVE COLIN COUNT
82     0059 33      SPAL P3
83     0060 340F     JP GENCOL2 ; COL COUNT/8
84     0061 C102     LD TEMP2(P1) ; DET COL COUNT
85     0062 F400     RD1 0F0 ; ADD ADPS FOR COLWORD
86     0063 32      SPAL P2
87     0064 C2FF     LD (P2) ; COLWORD CONST TO ACU
88     0065 D105     AND CLM1(P1) ; GENERATE COLWORD1
89     0066 C305     ST CLM1(P1) ; SAVE NEW COLWORD1
90     0067 C102     COLZBETP LD CLM2(P1) ; LD COLIN COUNT
91     0068 340F     JMP SCHNCK ; GO TO SCNN COMPLY CH
92     0069 C102     GENCOL2 LD TEMP2(P1) ; GET COL COUNT
93     0070 32      CLCTR(P1)
94     0071 F4F0     RD1 0F0 ; ADD ADPS FOR COLWORD
95     0072 32      SPAL P2
96     0073 C2FF     LD (P2) ; COLWORD CONST TO ACU
97     0074 D106     AND CLM2(P1) ; GENERATE COLWORD2
98     0075 C306     ST CLM2(P1) ; SAVE NEW COLWORD2
99     0076 30EE     JMP COLZBET
100
101     0077 06      FISHSCH CSA ANI 010 ; XFR SENSER TO ACU
102     0078 C410     LD1 010 ; CHECK IF SENSE A PRE
103     0079 30F0     JZ FISHSCH ; LOOP BACK TO FINISH
104     0080 C400     LD1 010 ; SET SENS0 ADPS
105     0081 33      SPAL P3
106     0082 C402     LD1 H'(SEI0)
107     0083 37      SPAN P3
108     0084 C105     LD CLM1(P1) ; GET COLWORD1
109     0085 C002     ST CLM2(P1) ; XFR COLWORD1 TO PRINT
110     0086 C106     LD CLM2(P1) ; GET COLWORD2
111     0087 C001     ST CLM1(P1) ; XFR COLWORD2 TO PRINT
112     0088 F004     ILD 13 ; INCREMENT CLK COUNTER
113     0089 E400     XRI 13 ; CHECK CLK CTR = 13
114     0090 3000     JZ DONE
115     0091 C400     LD1 0
116     0092 27      SPAN P3
117     0093 C415     LD1 015
118     0094 33      SPAN P3
119     0095 33FF     JMP (P3)
120     0096 C4FF     LD1 OFF
121     0097 CB03     ST CLM3(P3) ; CLR PRTP LATCHES
122
123     123      EXIT ; USER RETURN ROUTINE
124
125     00C0      =0C0
126     00C0 43      COL1 BYTE 'C','I','I','U','S','G','A','H'
127     00C1 49      COL2 21
128     00C2 21      COL2 21
129     00C3 35      COL2 35
130     00C4 35      COL2 35
131     00C5 26      COL2 26
132     00C6 41      COL2 41
133     00C7 40      COL2 40
134     00C8 4B      COL2 4B
135     00C9 45      COL2 45
136     00CA 50      COL2 50
137     00CB 4E      COL2 4E
138
139     00D0      =0D0
140     00D0 2A      COL2 2A
141     00D1 23      COL2 23
142     00D2 38      COL2 38
143     00D3 20      COL2 20
144     00D4 25      COL2 25
145     00D5 3D      COL2 3D
146     00D6 36      COL2 36
147     00D7 37      COL2 37
148     00D8 3A      COL2 3A
149     00D9 54      COL2 54
150     00DA 3A      COL2 3A
151     00DB 50      COL2 50
152
153     00E0      =0E0
154     00E0 30      COL4 30
155     00E1 31      COL4 31
156     00E2 32      COL4 32
157     00E3 33      COL4 33
158     00E4 34      COL4 34
159     00E5 35      COL4 35
160     00E6 36      COL4 36
161     00E7 37      COL4 37
162     00E8 38      COL4 38
163     00E9 39      COL4 39
164     00EA 2E      COL4 2E
165     00EB 20      COL4 20
166
167     00F0      =0F0
168     00F0 FE      CONST. BYTE 0FE,0FD,0FB,0F7,0EF,0DF,0BF,07F
169     00F1 FD      CONST. 0F1 FD
170     00F2 FD      CONST. 0F2 FD
171     00F3 F7      CONST. 0F3 F7
172     00F4 EF      CONST. 0F4 EF
173     00F5 0F      CONST. 0F5 0F
174     00F6 0F      CONST. 0F6 0F
175     00F7 7F      CONST. 0F7 7F
176     00F8 FE      CONST. 0F8 FE
177     00F9 FD      CONST. 0F9 FD
178     00FA FD      CONST. 0FA FD
179     00FB F7      CONST. 0FB F7
180     00FC 0F      CONST. 0FC 0F
181     00FD 0F      CONST. 0FD 0F
182     00FE 7F      CONST. 0FE 7F
183
184     0001      END PRNT
185
186     0001      CLM1 0001 CLM2 0002 CLM3 0003
187     0002      COL1 00C0 * COL2 00C0 * COL3 00C0 *
188     0003      COL4 00E0 * COL5 00E0 * COL6 00E0 *
189     0004      COL7 00F0 * COL8 00F0 * COL9 00F0 *
190     0005      CONTRP 0014 CONTRP2 0015 CONTRP3 0016
191     0006      CONTRP4 0017 CONTRP5 0018 CONTRP6 0019
192     0007      CONTRP7 0020 CONTRP8 0021 CONTRP9 0022
193     0008      CONTRP10 0023 CONTRP11 0024 CONTRP12 0025
194     0009      CONTRP13 0026 CONTRP14 0027 CONTRP15 0028
195     0010      CONTRP16 0029 CONTRP17 0030 CONTRP18 0031
196     0011      CONTRP19 0032 CONTRP20 0033 CONTRP21 0034
197     0012      CONTRP22 0035 CONTRP23 0036 CONTRP24 0037
198     0013      CONTRP25 0038 CONTRP26 0039 CONTRP27 0040
199     0014      CONTRP28 0041 CONTRP29 0042 CONTRP30 0043
200     0015      CONTRP31 0044 CONTRP32 0045 CONTRP33 0046
201     0016      CONTRP34 0047 CONTRP35 0048 CONTRP36 0049
202     0017      CONTRP37 0050 CONTRP38 0051 CONTRP39 0052
203     0018      CONTRP40 0053 CONTRP41 0054 CONTRP42 0055
204     0019      CONTRP43 0056 CONTRP44 0057 CONTRP45 0058
205     0020      CONTRP46 0059 CONTRP47 0060 CONTRP48 0061
206     0021      CONTRP49 0062 CONTRP50 0063 CONTRP51 0064
207     0022      CONTRP52 0065 CONTRP53 0066 CONTRP54 0067
208     0023      CONTRP55 0068 CONTRP56 0069 CONTRP57 0070
209     0024      CONTRP58 0071 CONTRP59 0072 CONTRP60 0073
210     0025      CONTRP61 0074 CONTRP62 0075 CONTRP63 0076
211     0026      CONTRP64 0077 CONTRP65 0078 CONTRP66 0079
212     0027      CONTRP67 0080 CONTRP68 0081 CONTRP69 0082
213     0028      CONTRP70 0083 CONTRP71 0084 CONTRP72 0085
214     0029      CONTRP73 0086 CONTRP74 0087 CONTRP75 0088
215     0030      CONTRP76 0089 CONTRP77 0090 CONTRP78 0091
216     0031      CONTRP79 0092 CONTRP80 0093 CONTRP81 0094
217     0032      CONTRP82 0095 CONTRP83 0096 CONTRP84 0097
218     0033      CONTRP85 0098 CONTRP86 0099 CONTRP87 0100
219     0034      CONTRP88 0101 CONTRP89 0102 CONTRP90 0103
220     0035      CONTRP91 0104 CONTRP92 0105 CONTRP93 0106
221     0036      CONTRP94 0107 CONTRP95 0108 CONTRP96 0109
222     0037      CONTRP97 0110 CONTRP98 0111 CONTRP99 0112
223     0038      CONTRP100 0113 CONTRP101 0114 CONTRP102 0115
224     0039      CONTRP103 0116 CONTRP104 0117 CONTRP105 0118
225     0040      CONTRP106 0119 CONTRP107 0120 CONTRP108 0121
226     0041      CONTRP109 0122 CONTRP110 0123 CONTRP111 0124
227     0042      CONTRP112 0125 CONTRP113 0126 CONTRP114 0127
228     0043      CONTRP115 0128 CONTRP116 0129 CONTRP117 0130
229     0044      CONTRP118 0131 CONTRP119 0132 CONTRP120 0133
230     0045      CONTRP121 0134 CONTRP122 0135 CONTRP123 0136
231     0046      CONTRP124 0137 CONTRP125 0138 CONTRP126 0139
232     0047      CONTRP127 0140 CONTRP128 0141 CONTRP129 0142
233     0048      CONTRP130 0143 CONTRP131 0144 CONTRP132 0145
234     0049      CONTRP133 0146 CONTRP134 0147 CONTRP135 0148
235     0050      CONTRP136 0149 CONTRP137 0150 CONTRP138 0151
236     0051      CONTRP139 0152 CONTRP140 0153 CONTRP141 0154
237     0052      CONTRP142 0155 CONTRP143 0156 CONTRP144 0157
238     0053      CONTRP145 0158 CONTRP146 0159 CONTRP147 0160
239     0054      CONTRP148 0161 CONTRP149 0162 CONTRP150 0163
240     0055      CONTRP151 0164 CONTRP152 0165 CONTRP153 0166
241     0056      CONTRP154 0167 CONTRP155 0168 CONTRP156 0169
242     0057      CONTRP157 0170 CONTRP158 0171 CONTRP159 0172
243     0058      CONTRP160 0173 CONTRP161 0174 CONTRP162 0175
244     0059      CONTRP163 0176 CONTRP164 0177 CONTRP165 0178
245     0060      CONTRP166 0179 CONTRP167 0180 CONTRP168 0181
246     0061      CONTRP169 0182 CONTRP170 0183 CONTRP171 0184
247     0062      CONTRP172 0185 CONTRP173 0186 CONTRP174 0187
248     0063      CONTRP175 0188 CONTRP176 0189 CONTRP177 0190
249     0064      CONTRP178 0191 CONTRP179 0192 CONTRP180 0193
250     0065      CONTRP181 0194 CONTRP182 0195 CONTRP183 0196
251     0066      CONTRP184 0197 CONTRP185 0198 CONTRP186 0199
252     0067      CONTRP187 0200 CONTRP188 0201 CONTRP189 0202
253     0068      CONTRP190 0203 CONTRP191 0204 CONTRP192 0205
254     0069      CONTRP193 0206 CONTRP194 0207 CONTRP195 0208
255     0070      CONTRP196 0209 CONTRP197 0210 CONTRP198 0211
256     0071      CONTRP199 0212 CONTRP200 0213 CONTRP201 0214
257     0072      CONTRP202 0215 CONTRP203 0216 CONTRP204 0217
258     0073      CONTRP205 0218 CONTRP206 0219 CONTRP207 0220
259     0074      CONTRP208 0221 CONTRP209 0222 CONTRP210 0223
260     0075      CONTRP211 0224 CONTRP212 0225 CONTRP213 0226
261     0076      CONTRP214 0227 CONTRP215 0228 CONTRP216 0229
262     0077      CONTRP217 0230 CONTRP218 0231 CONTRP219 0232
263     0078      CONTRP220 0233 CONTRP221 0234 CONTRP222 0235
264     0079      CONTRP223 0236 CONTRP224 0237 CONTRP225 0238
265     0080      CONTRP226 0239 CONTRP227 0240 CONTRP228 0241
266     0081      CONTRP229 0242 CONTRP230 0243 CONTRP231 0244
267     0082      CONTRP232 0245 CONTRP233 0246 CONTRP234 0247
268     0083      CONTRP235 0248 CONTRP236 0249 CONTRP237 0250
269     0084      CONTRP238 0251 CONTRP239 0252 CONTRP240 0253
270     0085      CONTRP241 0254 CONTRP242 0255 CONTRP243 0256
271     0086      CONTRP244 0257 CONTRP245 0258 CONTRP246 0259
272     0087      CONTRP247 0260 CONTRP248 0261 CONTRP249 0262
273     0088      CONTRP250 0263 CONTRP251 0264 CONTRP252 0265
274     0089      CONTRP253 0266 CONTRP254 0267 CONTRP255 0268
275     0090      CONTRP256 0269 CONTRP257 0270 CONTRP258 0271
276     0091      CONTRP259 0272 CONTRP260 0273 CONTRP261 0274
277     0092      CONTRP262 0275 CONTRP263 0276 CONTRP264 0277
278     0093      CONTRP265 0278 CONTRP266 0279 CONTRP267 0280
279     0094      CONTRP268 0281 CONTRP269 0282 CONTRP270 0283
280     0095      CONTRP271 0284 CONTRP272 0285 CONTRP273 0286
281     0096      CONTRP274 0287 CONTRP275 0288 CONTRP276 0289
282     0097      CONTRP277 0290 CONTRP278 0291 CONTRP279 0292
283     0098      CONTRP280 0293 CONTRP281 0294 CONTRP282 0295
284     0099      CONTRP283 0296 CONTRP284 0297 CONTRP285 0298
285     0100      CONTRP286 0299 CONTRP287 0300 CONTRP288 0301
286     0101      CONTRP289 0302 CONTRP290 0303 CONTRP291 0304
287     0102      CONTRP292 0305 CONTRP293 0306 CONTRP294 0307
288     0103      CONTRP295 0308 CONTRP296 0309 CONTRP297 0310
289     0104      CONTRP298 0311 CONTRP299 0312 CONTRP300 0313
290     0105      CONTRP301 0314 CONTRP302 0315 CONTRP303 0316
291     0106      CONTRP304 0317 CONTRP305 0318 CONTRP306 0319
292     0107      CONTRP307 0320 CONTRP308 0321 CONTRP309 0322
293     0108      CONTRP310 0323 CONTRP311 0324 CONTRP312 0325
294     0109      CONTRP313 0326 CONTRP314 0327 CONTRP315 0328
295     0110      CONTRP316 0329 CONTRP317 0330 CONTRP318 0331
296     0111      CONTRP319 0332 CONTRP320 0333 CONTRP321 0334
297     0112      CONTRP322 0335 CONTRP323 0336 CONTRP324 0337
298     0113      CONTRP325 0338 CONTRP326 0339 CONTRP327 0340
299     0114      CONTRP328 0341 CONTRP329 0342 CONTRP330 0343
300     0115      CONTRP331 0344 CONTRP332 0345 CONTRP333 0346
301     0116      CONTRP334 0347 CONTRP335 0348 CONTRP336 0349
302     0117      CONTRP337 0350 CONTRP338 0351 CONTRP339 0352
303     0118      CONTRP340 0353 CONTRP341 0354 CONTRP342 0355
304     0119      CONTRP343 0356 CONTRP344 0357 CONTRP345 0358
305     0120      CONTRP346 0359 CONTRP347 0360 CONTRP348 0361
306     0121      CONTRP349 0362 CONTRP350 0363 CONTRP351 0364
307     0122      CONTRP352 0365 CONTRP353 0366 CONTRP354 0367
308     0123      CONTRP355 0368 CONTRP356 0369 CONTRP357 0370
309     0124      CONTRP358 0371 CONTRP359 0372 CONTRP360 0373
310     0125      CONTRP361 0374 CONTRP362 0375 CONTRP363 0376
311     0126      CONTRP364 0377 CONTRP365 0378 CONTRP366 0379
312     0127      CONTRP367 0380 CONTRP368 0381 CONTRP369 0382
313     0128      CONTRP370 0383 CONTRP371 0384 CONTRP372 0385
314     0129      CONTRP373 0386 CONTRP374 0387 CONTRP375 0388
315     0130      CONTRP376 0389 CONTRP377 0390 CONTRP378 0391
316     0131      CONTRP379 0392 CONTRP380 0393 CONTRP381 0394
317     0132      CONTRP382 0395 CONTRP383 0396 CONTRP384 0397
318     0133      CONTRP385 0398 CONTRP386 0399 CONTRP387 0400
319     0134      CONTRP388 0401 CONTRP389 0402 CONTRP390 0403
320     0135      CONTRP391 0404 CONTRP392 0405 CONTRP393 0406
321     0136      CONTRP394 0407 CONTRP395 0408 CONTRP396 0409
322     0137      CONTRP397 0410 CONTRP398 0411 CONTRP399 0412
323     0138      CONTRP400 0413 CONTRP401 0414 CONTRP402 0415
324     0139      CONTRP403 0416 CONTRP404 0417 CONTRP405 0418
325     0140      CONTRP406 0419 CONTRP407 0420 CONTRP408 0421
326     0141      CONTRP409 0422 CONTRP410 0423 CONTRP411 0424
327     0142      CONTRP412 0425 CONTRP413 0426 CONTRP414 0427
328     0143      CONTRP415 0428 CONTRP416 0429 CONTRP417 0430
329     0144      CONTRP418 0431 CONTRP419 0432 CONTRP420 0433
330     0145      CONTRP421 0434 CONTRP422 0435 CONTRP423 0436
331     0146      CONTRP424 0437 CONTRP425 0438 CONTRP426 0439
332     0147      CONTRP427 0440 CONTRP428 0441 CONTRP429 0442
333     0148      CONTRP430 0443 CONTRP431 0444 CONTRP432 0445
334     0149      CONTRP433 0446 CONTRP434 0447 CONTRP435 0448
335     0150      CONTRP436 0449 CONTRP437 0450 CONTRP438 0451
336     0151      CONTRP439 0452 CONTRP440 0453 CONTRP441 0454
337     0152      CONTRP442 0455 CONTRP443 0456 CONTRP444 0457
338     0153      CONTRP445 0458 CONTRP446 0459 CONTRP447 0460
339     0154      CONTRP448 0461 CONTRP449 0462 CONTRP450 0463
340     0155      CONTRP451 0464 CONTRP452 0465 CONTRP453 0466
341     0156      CONTRP454 0467 CONTRP455 0468 CONTRP456 0469
342     0157      CONTRP457 0470 CONTRP458 0471 CONTRP459 0472
343     0158      CONTRP460 0473 CONTRP461 0474 CONTRP462 0475
344     0159      CONTRP463 0476 CONTRP464 0477 CONTRP465 0478
345     0160      CONTRP466 0479 CONTRP467 0480 CONTRP468 0481
346     0161      CONTRP469 0482 CONTRP470 0483 CONTRP471 0484
347     0162      CONTRP472 0485 CONTRP473 0486 CONTRP474 0487
348     0163      CONTRP475 0488 CONTRP476 0489 CONTRP477 0490
349     0164      CONTRP478 0491 CONTRP479 0492 CONTRP480 0493
350     0165      CONTRP481 0494 CONTRP482 0495 CONTRP483 0496
351     0166      CONTRP484 0497 CONTRP485 0498 CONTRP486 0499
352     0167      CONTRP487 0500 CONTRP488 0501 CONTRP489 0502
353     0168      CONTRP490 0503 CONTRP491 0504 CONTRP492 0505
354     0169      CONTRP493 0506 CONTRP494 0507 CONTRP495 0508
355     0170      CONTRP496 0509 CONTRP497 0510 CONTRP498 0511
356     0171      CONTRP499 0512 CONTRP500 0513 CONTRP501 0514
357     0172      CONTRP502 0515 CONTRP503 0516 CONTRP504 0517
358     0173      CONTRP505 0518 CONTRP506 0519 CONTRP507 0520
359     0174      CONTRP508 0521 CONTRP509 0522 CONTRP510 0523
360     0175      CONTRP511 0524 CONTRP512 0525 CONTRP513 0526
361     0176      CONTRP514 0527 CONTRP515 0528 CONTRP516 0529
362     0177      CONTRP517 0530 CONTRP518 0531 CONTRP519 0532
363     0178      CONTRP520 0533 CONTRP521 0534 CONTRP522 0535
364     0179      CONTRP523 0536 CONTRP524 0537 CONTRP525 0538
365     0180      CONTRP526 0539 CONTRP527 0540 CONTRP528 0541
366     0181      CONTRP529 0542 CONTRP530 0543 CONTRP531 0544
367     0182      CONTRP532 0545 CONTRP533 0546 CONTRP534 0547
368     0183      CONTRP535 0548 CONTRP536 0549 CONTRP537 0550
369     0184      CONTRP538 0551 CONTRP539 0552 CONTRP540 0553
370     0185      CONTRP541 0554 CONTRP542 0555 CONTRP543 0556
371     0186      CONTRP544 0557 CONTRP545 0558 CONTRP546 0559
372     0187      CONTRP547 0560 CONTRP548 0561 CONTRP549 0562
373     0188      CONTRP550 0563 CONTRP551 0564 CONTRP552 0565
374     0189      CONTRP553 0566 CONTRP554 0567 CONTRP555 0568
375     0190      CONTRP556 0569 CONTRP557 0570 CONTRP558 0571
376     0191      CONTRP559 0572 CONTRP560 0573 CONTRP561 0574
377     0192      CONTRP562 0575 CONTRP563 0576 CONTRP564 0577
378     0193      CONTRP565 0578 CONTRP566 0579 CONTRP567 0580
379     0194      CONTRP568 0581 CONTRP569 0582 CONTRP570 0583
380     0195      CONTRP571 0584 CONTRP572 0585 CONTRP573 0586
381     0196      CONTRP574 0587 CONTRP575 0588 CONTRP576 0589
382     0197      CONTRP577 0590 CONTRP578 0591 CONTRP579 0592
383     0198      CONTRP580 0593 CONTRP581 0594 CONTRP582 0595
384     0199      CONTRP583 0596 CONTRP584 0597 CONTRP585 0598
385     0200      CONTRP586 0599 CONTRP587 0600 CONTRP588 0601
386     0201      CONTRP589 0602 CONTRP590 0603 CONTRP591 0604
387     0202      CONTRP592 0605 CONTRP593 0606 CONTRP594 0607
388     0203      CONTRP595 0608 CONTRP596 0609 CONTRP597 0610
389     0204      CONTRP598 0611 CONTRP599 0612 CONTRP600 0613
390     0205      CONTRP601 0614 CONTRP602 0615 CONTRP603 0616
391     0206      CONTRP604 0617 CONTRP605 0618 CONTRP606 0619
392     0207      CONTRP607 0620 CONTRP608 0621 CONTRP609 0622
393     0208      CONTRP610 0623 CONTRP611 0624 CONTRP612 0625
394     0209      CONTRP613 0626 CONTRP614 0627 CONTRP615 0628
395     0210      CONTRP616 0629 CONTRP617 0630 CONTRP618 0631
396     0211      CONTRP619 0632 CONTRP620 0633 CONTRP621 0634
397     0212      CONTRP622 0635 CONTRP623 0636 CONTRP624 0637
398     0213      CONTRP625 0638 CONTRP626 0639 CONTRP627 0640
399     0214      CONTRP628 0641 CONTRP629 0642 CONTR
```

# DIGI-KEY CORPORATION

## Quality Electronic Components

### DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

### PRICE BREAKTHROUGH ON 74LS!

741000	741001	741002	741003	741004	741005	741006	741007	741008	741009	741010	741011	741012	741013	741014	741015	741016	741017	741018	741019	741020	741021	741022	741023	741024	741025	741026	741027	741028	741029	741030	741031	741032	741033	741034	741035	741036	741037	741038	741039	741040	741041	741042	741043	741044	741045	741046	741047	741048	741049	741050	741051	741052	741053	741054	741055	741056	741057	741058	741059	741060	741061	741062	741063	741064	741065	741066	741067	741068	741069	741070	741071	741072	741073	741074	741075	741076	741077	741078	741079	741080	741081	741082	741083	741084	741085	741086	741087	741088	741089	741090	741091	741092	741093	741094	741095	741096	741097	741098	741099	741100	741101	741102	741103	741104	741105	741106	741107	741108	741109	741110	741111	741112	741113	741114	741115	741116	741117	741118	741119	741120	741121	741122	741123	741124	741125	741126	741127	741128	741129	741130	741131	741132	741133	741134	741135	741136	741137	741138	741139	741140	741141	741142	741143	741144	741145	741146	741147	741148	741149	741150	741151	741152	741153	741154	741155	741156	741157	741158	741159	741160	741161	741162	741163	741164	741165	741166	741167	741168	741169	741170	741171	741172	741173	741174	741175	741176	741177	741178	741179	741180	741181	741182	741183	741184	741185	741186	741187	741188	741189	741190	741191	741192	741193	741194	741195	741196	741197	741198	741199	741200	741201	741202	741203	741204	741205	741206	741207	741208	741209	741210	741211	741212	741213	741214	741215	741216	741217	741218	741219	741220	741221	741222	741223	741224	741225	741226	741227	741228	741229	741230	741231	741232	741233	741234	741235	741236	741237	741238	741239	741240	741241	741242	741243	741244	741245	741246	741247	741248	741249	741250	741251	741252	741253	741254	741255	741256	741257	741258	741259	741260	741261	741262	741263	741264	741265	741266	741267	741268	741269	741270	741271	741272	741273	741274	741275	741276	741277	741278	741279	741280	741281	741282	741283	741284	741285	741286	741287	741288	741289	741290	741291	741292	741293	741294	741295	741296	741297	741298	741299	741300	741301	741302	741303	741304	741305	741306	741307	741308	741309	741310	741311	741312	741313	741314	741315	741316	741317	741318	741319	741320	741321	741322	741323	741324	741325	741326	741327	741328	741329	741330	741331	741332	741333	741334	741335	741336	741337	741338	741339	741340	741341	741342	741343	741344	741345	741346	741347	741348	741349	741350	741351	741352	741353	741354	741355	741356	741357	741358	741359	741360	741361	741362	741363	741364	741365	741366	741367	741368	741369	741370	741371	741372	741373	741374	741375	741376	741377	741378	741379	741380	741381	741382	741383	741384	741385	741386	741387	741388	741389	741390	741391	741392	741393	741394	741395	741396	741397	741398	741399	741400	741401	741402	741403	741404	741405	741406	741407	741408	741409	741410	741411	741412	741413	741414	741415	741416	741417	741418	741419	741420	741421	741422	741423	741424	741425	741426	741427	741428	741429	741430	741431	741432	741433	741434	741435	741436	741437	741438	741439	741440	741441	741442	741443	741444	741445	741446	741447	741448	741449	741450	741451	741452	741453	741454	741455	741456	741457	741458	741459	741460	741461	741462	741463	741464	741465	741466	741467	741468	741469	741470	741471	741472	741473	741474	741475	741476	741477	741478	741479	741480	741481	741482	741483	741484	741485	741486	741487	741488	741489	741490	741491	741492	741493	741494	741495	741496	741497	741498	741499	741500	741501	741502	741503	741504	741505	741506	741507	741508	741509	741510	741511	741512	741513	741514	741515	741516	741517	741518	741519	741520	741521	741522	741523	741524	741525	741526	741527	741528	741529	741530	741531	741532	741533	741534	741535	741536	741537	741538	741539	741540	741541	741542	741543	741544	741545	741546	741547	741548	741549	741550	741551	741552	741553	741554	741555	741556	741557	741558	741559	741560	741561	741562	741563	741564	741565	741566	741567	741568	741569	741570	741571	741572	741573	741574	741575	741576	741577	741578	741579	741580	741581	741582	741583	741584	741585	741586	741587	741588	741589	741590	741591	741592	741593	741594	741595	741596	741597	741598	741599	741600	741601	741602	741603	741604	741605	741606	741607	741608	741609	741610	741611	741612	741613	741614	741615	741616	741617	741618	741619	741620	741621	741622	741623	741624	741625	741626	741627	741628	741629	741630	741631	741632	741633	741634	741635	741636	741637	741638	741639	741640	741641	741642	741643	741644	741645	741646	741647	741648	741649	741650	741651	741652	741653	741654	741655	741656	741657	741658	741659	741660	741661	741662	741663	741664	741665	741666	741667	741668	741669	741670	741671	741672	741673	741674	741675	741676	741677	741678	741679	741680	741681	741682	741683	741684	741685	741686	741687	741688	741689	741690	741691	741692	741693	741694	741695	741696	741697	741698	741699	741700	741701	741702	741703	741704	741705	741706	741707	741708	741709	741710	741711	741712	741713	741714	741715	741716	741717	741718	741719	741720	741721	741722	741723	741724	741725	741726	741727	741728	741729	741730	741731	741732	741733	741734	741735	741736	741737	741738	741739	741740	741741	741742	741743	741744	741745	741746	741747	741748	741749	741750	741751	741752	741753	741754	741755	741756	741757	741758	741759	741760	741761	741762	741763	741764	741765	741766	741767	741768	741769	741770	741771	741772	741773	741774	741775	741776	741777	741778	741779	741780	741781	741782	741783	741784	741785	741786	741787	741788	741789	741790	741791	741792	741793	741794	741795	741796	741797	741798	741799	741800	741801	741802	741803	741804	741805	741806	741807	741808	741809	741810	741811	741812	741813	741814	741815	741816	741817	741818	741819	741820	741821	741822	741823	741824	741825	741826	741827	741828	741829	741830	741831	741832	741833	741834	741835	741836	741837	741838	741839	741840	741841	741842	741843	741844	741845	741846	741847	741848	741849	741850	741851	741852	741853	741854	741855	741856	741857	741858	741859	741860	741861	741862	741863	741864	741865	741866	741867	741868	741869	741870	741871	741872	741873	741874	741875	741876	741877	741878	741879	741880	741881	741882	741883	741884	741885	741886	741887	741888	741889	741890	741891	741892	741893	741894	741895	741896	741897	741898	741899	741900	741901	741902	741903	741904	741905	741906	741907	741908	741909	741910	741911	741912	741913	741914	741915	741916	741917	741918	741919	741920	741921	741922	741923	741924	741925	741926	741927	741928	741929	741930	741931	741932	741933	741934	741935	741936	741937	741938	741939	741940	741941	741942	741943	741944	741945	741946	741947	741948	741949	741950	741951	741952	741953	741954	741955	741956	741957	741958	741959	741960	741961	741962	741963	741964	741965	741966	741967	741968	741969	741970	741971	741972	741973	741974	741975	741976	741977	741978	741979	741980	741981	741982	741983	741984	741985	741986	741987	741988	741989	741990	741991	741992	741993	741994	741995	741996	741997	741998	741999	742000	742001	742002	742003	742004	742005	742006	742007	742008	742009	742010	742011	742012	742013	742014	742015	742016	742017	742018	742019	742020	742021	742022	742023	742024	742025	742026	742027	742028	742029	742030	742031	742032	742033	742034	742035	742036	742037	742038	742039	742040	742041	742042	742043	742044	742045	742046	742047	742048	742049	742050	742051	742052	742053	742054	742055	742056	742057	742058	742059	742060	742061	742062	742063	742064	742065	742066	742067	742068	742069	742070	742071	742072	742073	742074	742075	742076	742077	742078	742079	742080	742081	742082	742083	742084	742085	742086	742087	742088	742089	742090	742091	742092	742093	742094	742095	742096	742097	742098	742099	742100	742101	742102	742103	742104	742105	742106	742107	742108	742109	742110	742111	742112	742113	74
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	----



# CHECKBOOK BALANCER PROGRAM — JHCBBP

by Jim Huffman

## INTRODUCTION

Here's another one of those practical applications of the computer that should tend to help you to be able to justify to your spouse why you've got a couple thousand dollars tucked away in the basement. This particular program uses a balance from your checking account statement, subtracts service charges, and calculates checkbook balance from the outstanding checks and deposits you enter. These would be the checks and deposits not shown on your statement. The program also uses an adding machine entry format—that is, you do not add the decimal point. One hundred dollars would be represented as 10000. The computer then divides it by 100 to provide the display of 100.00.

## PROGRAM CONFIGURATION

While this program should run easily in anyone's BASIC, there may be some modifications to the control statements. One: DIGITS = 2 is valid for SWTPC 6800 8K Basic, but may not be valid for your BASIC. Also, STEP 9 has a control function that causes home-up and erase the screen on my CT1024 terminal. Your terminal may be different. In fact, if you have a scrolling terminal, you may decide to put in 16 line feeds or whatever in order to clear the screen.

## RUNNING PROGRAM

The program listing is self-explanatory. One of its nicer features is that after receiving what the balance should be and how many checks have been written, you may re-enter more checks or deposits that you may have stumbled on in going over your checkbook without restarting the program and losing all the data that you already had in. You will automatically get the number of checks and number of deposits, the total of the checks and deposits, and the final balance. Again, note step 185; the home-up and erase function is used again before the data is displayed so that it will be displayed on a clean screen.

## PROGRAM EXAMPLES

```
#RUN
BALANCE FROM STATEMENT?10000
SERVICE CHARGES?500
```

ENTER AMOUNT (NO DECIMALS) OF ITEMS NOT  
ON STATEMENT

```
CHECKS FIRST
ENTER 0 TO TERMINATE
ENTER?597
ENTRY?475
ENTRY?12345
ENTRY?0
```

NOW DEPOSITS—ENTER 0 TO TERMINATE  
ENTRY?20000  
ENTRY?0

FINAL BALANCE SHOULD BE \$160.83

FROM STATEMENT: BAL 100 LESS SURCHARGE 5 = 95  
TOTAL CHECKS = 3 for \$134.17  
TOTAL DEPOS = 1 FOR \$200

MORE ENTRIES (Y OR N)?Y

ENTER AMOUNT (NO DECIMALS) OF ITEMS NOT  
ON STATEMENT

CHECKS FIRST  
ENTER 0 TO TERMINATE  
ENTRY?395  
ENTRY?0

NOW DEPOSITS—ENTER 0 TO TERMINATE  
ENTRY?0

FINAL BALANCE SHOULD BE \$156.88

FROM STATEMENT: BAL 100 LESS SURCHARGE 5 = 95  
TOTAL CHECKS = 4 FOR \$138.12  
TOTAL DEPOS = 1 FOR \$200

MORE ENTRIES? (Y OR N)?N

## PROGRAM BASIC LISTING

```

0000  RM  CMCCHQCHK BALANCE=
0001  RM  PARCEMENTEN BY J. J. HOFFMAN
0002  RM  01-01-57
0003  RM  MICHIGANSTATEUNIVERSITY SUTS AREA
0004  RM  MICHIGAN STATE SOFTWARES IN MICHIG
0005  RM  PRINT *****
0006  RM  ENMIT BALANCE FROM STATEMENTS,H
0007  RM  INPUT "SERVICE CHARGES="
0008  RM  INPUT "ENTER AMOUNT (CAN DECIMALS) OF ITEMS NOT ON STATEMENT="
0009  RM  INPUT "***** FINISH *****"
0010  RM  INPUT "ENTER A TO TERMINATE"
0011  RM  INPUT "*****"
0012  RM  IF P=0 THEN I=0
0013  RM  LET I=I+1
0014  RM  GOTO A
0015  RM  PRINT "NOY DEPOSITS---ENTER A TO TERMINATE"
0016  RM  INPUT "*****"
0017  RM  IF P=0 THEN I=0
0018  RM  LET I=I+1
0019  RM  GOTO A
0020  RM  PRINT "*****"
0021  RM  PRINT "*****"
0022  RM  PRINT "*****"
0023  RM  PRINT "*****"
0024  RM  PRINT "*****"
0025  RM  PRINT "*****"
0026  RM  PRINT "*****"
0027  RM  PRINT "*****"
0028  RM  PRINT "*****"
0029  RM  PRINT "*****"
0030  RM  PRINT "*****"
0031  RM  PRINT "*****"
0032  RM  PRINT "*****"
0033  RM  PRINT "*****"
0034  RM  PRINT "*****"
0035  RM  PRINT "*****"
0036  RM  PRINT "*****"
0037  RM  PRINT "*****"
0038  RM  PRINT "*****"
0039  RM  PRINT "*****"
0040  RM  PRINT "*****"
0041  RM  PRINT "*****"
0042  RM  PRINT "*****"
0043  RM  PRINT "*****"
0044  RM  PRINT "*****"
0045  RM  PRINT "*****"
0046  RM  PRINT "*****"
0047  RM  PRINT "*****"
0048  RM  PRINT "*****"
0049  RM  PRINT "*****"
0050  RM  PRINT "*****"
0051  RM  PRINT "*****"
0052  RM  PRINT "*****"
0053  RM  PRINT "*****"
0054  RM  PRINT "*****"
0055  RM  PRINT "*****"
0056  RM  PRINT "*****"
0057  RM  PRINT "*****"
0058  RM  PRINT "*****"
0059  RM  PRINT "*****"
0060  RM  PRINT "*****"
0061  RM  PRINT "*****"
0062  RM  PRINT "*****"
0063  RM  PRINT "*****"
0064  RM  PRINT "*****"
0065  RM  PRINT "*****"
0066  RM  PRINT "*****"
0067  RM  PRINT "*****"
0068  RM  PRINT "*****"
0069  RM  PRINT "*****"
0070  RM  PRINT "*****"
0071  RM  PRINT "*****"
0072  RM  PRINT "*****"
0073  RM  PRINT "*****"
0074  RM  PRINT "*****"
0075  RM  PRINT "*****"
0076  RM  PRINT "*****"
0077  RM  PRINT "*****"
0078  RM  PRINT "*****"
0079  RM  PRINT "*****"
0080  RM  PRINT "*****"
0081  RM  PRINT "*****"
0082  RM  PRINT "*****"
0083  RM  PRINT "*****"
0084  RM  PRINT "*****"
0085  RM  PRINT "*****"
0086  RM  PRINT "*****"
0087  RM  PRINT "*****"
0088  RM  PRINT "*****"
0089  RM  PRINT "*****"
0090  RM  PRINT "*****"
0091  RM  PRINT "*****"
0092  RM  PRINT "*****"
0093  RM  PRINT "*****"
0094  RM  PRINT "*****"
0095  RM  PRINT "*****"
0096  RM  PRINT "*****"
0097  RM  PRINT "*****"
0098  RM  PRINT "*****"
0099  RM  PRINT "*****"
0100  RM  PRINT "*****"
0101  RM  PRINT "*****"
0102  RM  PRINT "*****"
0103  RM  PRINT "*****"
0104  RM  PRINT "*****"
0105  RM  PRINT "*****"
0106  RM  PRINT "*****"
0107  RM  PRINT "*****"
0108  RM  PRINT "*****"
0109  RM  PRINT "*****"
0110  RM  PRINT "*****"
0111  RM  PRINT "*****"
0112  RM  PRINT "*****"
0113  RM  PRINT "*****"
0114  RM  PRINT "*****"
0115  RM  PRINT "*****"
0116  RM  PRINT "*****"
0117  RM  PRINT "*****"
0118  RM  PRINT "*****"
0119  RM  PRINT "*****"
0120  RM  PRINT "*****"
0121  RM  PRINT "*****"
0122  RM  PRINT "*****"
0123  RM  PRINT "*****"
0124  RM  PRINT "*****"
0125  RM  PRINT "*****"
0126  RM  PRINT "*****"
0127  RM  PRINT "*****"
0128  RM  PRINT "*****"
0129  RM  PRINT "*****"
0130  RM  PRINT "*****"
0131  RM  PRINT "*****"
0132  RM  PRINT "*****"
0133  RM  PRINT "*****"
0134  RM  PRINT "*****"
0135  RM  PRINT "*****"
0136  RM  PRINT "*****"
0137  RM  PRINT "*****"
0138  RM  PRINT "*****"
0139  RM  PRINT "*****"
0140  RM  PRINT "*****"
0141  RM  PRINT "*****"
0142  RM  PRINT "*****"
0143  RM  PRINT "*****"
0144  RM  PRINT "*****"
0145  RM  PRINT "*****"
0146  RM  PRINT "*****"
0147  RM  PRINT "*****"
0148  RM  PRINT "*****"
0149  RM  PRINT "*****"
0150  RM  PRINT "*****"
0151  RM  PRINT "*****"
0152  RM  PRINT "*****"
0153  RM  PRINT "*****"
0154  RM  PRINT "*****"
0155  RM  PRINT "*****"
0156  RM  PRINT "*****"
0157  RM  PRINT "*****"
0158  RM  PRINT "*****"
0159  RM  PRINT "*****"
0160  RM  PRINT "*****"
0161  RM  PRINT "*****"
0162  RM  PRINT "*****"
0163  RM  PRINT "*****"
0164  RM  PRINT "*****"
0165  RM  PRINT "*****"
0166  RM  PRINT "*****"
0167  RM  PRINT "*****"
0168  RM  PRINT "*****"
0169  RM  PRINT "*****"
0170  RM  PRINT "*****"
0171  RM  PRINT "*****"
0172  RM  PRINT "*****"
0173  RM  PRINT "*****"
0174  RM  PRINT "*****"
0175  RM  PRINT "*****"
0176  RM  PRINT "*****"
0177  RM  PRINT "*****"
0178  RM  PRINT "*****"
0179  RM  PRINT "*****"
0180  RM  PRINT "*****"
0181  RM  PRINT "*****"
0182  RM  PRINT "*****"
0183  RM  PRINT "*****"
0184  RM  PRINT "*****"
0185  RM  PRINT "*****"
0186  RM  PRINT "*****"
0187  RM  PRINT "*****"
0188  RM  PRINT "*****"
0189  RM  PRINT "*****"
0190  RM  PRINT "*****"
0191  RM  PRINT "*****"
0192  RM  PRINT "*****"
0193  RM  PRINT "*****"
0194  RM  PRINT "*****"
0195  RM  PRINT "*****"
0196  RM  PRINT "*****"
0197  RM  PRINT "*****"
0198  RM  PRINT "*****"
0199  RM  PRINT "*****"
0200  RM  PRINT "*****"

```



# LOGAN . . .

## A Logic Circuit Analysis Program

by Robert J. Bishop

### INTRODUCTION

I think that I should preface this article by saying that I am not at all a "hardware type"; I have almost no experience in designing or constructing logic circuits. But the subject of logic gates is very fascinating. So one day I decided that it would be kind of fun to write a simple BASIC program for analyzing networks of logic gates. As a result, program LOGAN (LOGic Analysis) was created.

### GATES AND STATES

For the purposes of LOGAN, a *gate* is defined as a device which produces a single logical output *state* as a function of one or more logical input *states*. A binary logic *state* is a value of either 0 or 1, but I also allow for two more values: undefined and undefined. For brevity, I will sometimes use the symbol ? to represent undefined; correspondingly, the symbol ? will represent undefined. Now, it might be argued that a state can't be "undefined"; either it's a 1, or it isn't. While this may be true in any actual real world circuit, I still maintain that it is important to distinguish between those states that are actually *determined* vs those that just happen to turn on *randomly*. Thus, when LOGAN says that a state is a 1 (or a 0), it means that the logical state is definite and that the corresponding real world circuit will always have that uniquely same logical 1 (or 0) value.

If we allow for an undefined state, it soon becomes evident that we must also allow for the complementary state, undefined. For example, if the input to an inverter is undefined, what comes out? Is it also undefined? Well . . . yes, but in the opposite sense. Even though we may not know if the state is a 0 or a 1 we do know that it is the complement of whatever went in. Hence, if the input and output states were to be ORed together, the result would be a determined 1, even though the two ORed states were, in a sense, "undefined".

Figure 1 shows a set of Truth Tables for AND, OR, and exclusive OR (XOR) gates with two inputs. The complementary gates, NAND, NOR, and XNOR, are simply the complements of the tabular values in Figure 1.

### HOW TO USE LOGAN

The circuit to be investigated is specified as a network of gates and nodes (or lines). Each gate must have one, and only one, output node and from one to six input nodes. The only gates the program will recognize are: AND, OR, NAND, NOR, INV (inverter), XOR (exclusive OR), and XNOR (exclusive NOR).

Each node can exist in one of four states: 0, 1, ?, or  $\bar{?}$ . Any node not explicitly declared to be in either state 0 or state 1 will assume the default value of ?.

The program can handle up to 63 gates and up to 255

nodes. Each gate must be labeled with an integer number from 1 to 63, and each node must be labeled with an integer from 1 to 255. The order in which labels are assigned is immaterial, but each gate (or node) must be *uniquely* numbered in order to avoid ambiguity. Thus, although two different gates (or nodes) cannot both use the same numerical value as a label, a node and a gate can both use the same number as a label without confusion.

The program is modularly designed to perform any one of five tasks:

Task	Function
-2	Input the logic circuit.
-1	Input the defined states of nodes.
0	Analyze the circuit.
1	Output the defined states of nodes.
2	Output the logic circuit.

Notice the symmetry of the task numbers. A value of two refers to *specification of the circuit*. A NEGATIVE means that you specify to the computer; a positive means that the computer specifies to you. Similarly, a value of ONE refers

AND					
	0	1	?	$\bar{?}$	
0	0	0	0	0	0
1	0	1	?	?	?
?	0	?	?	?	0
$\bar{?}$	0	$\bar{?}$	0	?	$\bar{?}$

OR					
	0	1	?	$\bar{?}$	
0	0	1	?	?	?
1	1	1	1	1	1
?	?	1	?	?	1
$\bar{?}$	$\bar{?}$	1	1	?	$\bar{?}$

XOR					
	0	1	?	$\bar{?}$	
0	0	1	?	?	?
1	1	0	$\bar{?}$	?	?
?	?	?	0	1	?
$\bar{?}$	$\bar{?}$	?	1	0	?

Figure 1.

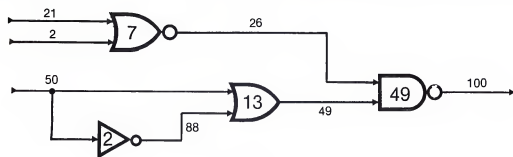


Figure 2.

to the specification of node states; the sign, again, indicates the *direction* of the specification.

Perhaps the easiest way to show how to use LOGAN is by working through a specific example. Figure 2 shows a simple logic circuit consisting of four gates and seven nodes. Suppose we are interested in the states of all nodes when node 21 is in state 1 and node 2 is in state 0.

Figure 3. Logic Analysis Program

```
TASK: ~-1
OLD: OF NEW: NEW!

LABEL: ?13      TASK: ~-1
GATE: ?00      CLEAR: ?YES
NODE: ?49      NODE: ?21
                     STATE: ?1
NODE: ?88      NODE: ?2
                     STATE: ?0
NODE: ?50      NODE: ?0
NODE: ?0      TASK: ?0
                     ITERATION 1
LABEL: ?7       TASK: ?1
GATE: ?00      2: 0 21 1 26 0 49 1 100 1
NODE: ?26      TASK: ?2
NODE: ?21      2: INV 88 50
NODE: ?2       7: NOR 26 21 2
NODE: ?0       13: OR 49 88 50
                     49: AND 100 26 49
LABEL: ?49      TASK: ?3
GATE: ?AND     >
NODE: ?100
NODE: ?26
NODE: ?49
NODE: ?0
LABEL: ?0
```

Figure 3 is a printout of LOGAN's run of the circuit shown in Figure 2. After identifying itself, the program asks for a task number. Since we wish to specify the circuit to the computer, we type: -2. The computer then asks us if the circuit we wish to specify is a new one, or do we wish to simply modify the old one currently in its memory. Since there isn't any old circuit at this point,

we respond with: NEW. After a slight pause the computer is ready to accept our circuit. It first asks for the numerical label of the gate. Since the order of specification is arbitrary, let's give it gate #13 first. Next, it asks for the node labels associated with the gate. The first node specified must be the output node of the gate. Thus we respond with: 49. It again asks for a node, but this time an input node. Since the order of indication is immaterial, we respond with: 88, and then: 50. It now asks for yet another input node (Remember, a gate can have as many as six inputs), but there are no more. So we terminate the queries by typing a zero. The program now advances to the next gate and asks for its label. We respond appropriately, as above, until all gates have been specified, at which point a label number of zero terminates this phase of the program and another task number is requested.

We now want to assign values to nodes 2 and 21, so we invoke task -1. The computer asks us if it should clear—set to undefined—all nodes. We reply: YES. It then asks for the label of a node whose state is to be specified. (Again, the order of specification is unimportant.) We type: 21, and then set its state to 1. Similarly, we specify the state of node 2 to be 0. Again, a label of zero terminates this phase, and the computer returns to the task requesting phase.

Our circuit is now in the memory and we are ready to "turn the computer loose" on it. So we invoke task 0, the heart of the program. After a couple of iterations the analysis is finished and control is again returned to the task requester.

To see the results of the analysis we ask the computer to display the states of all nodes whose states are currently DEFINED: we invoke task 1. It shows us that nodes 2 and 26 are both in state 0, while nodes 21, 49, and 100 are all in state 1. (Notice that the states of nodes 50 and 88 are not indicated, as these are not defined.)

For completeness, we can now tell the computer to show us the circuit currently in its memory. This, which is done by invoking task 2, serves as a way of checking that the circuit in memory is actually the one we intend to be there.

At this point, we could now change some of the input nodes' states and rerun the analysis. Or we might want to modify the circuit slightly first. For example, suppose we wanted to change gate 7 from a NOR to an AND gate. We would invoke task -2 and specify: OLD. We would then indicate that label 7 should be an AND gate, that its output node is number 26, and that its input nodes are 2 and 21. (Notice that all the parameters of a changed gate must be re-specified, even if some don't change.)

When we are completely finished with LOGAN, specifying a task of 3 terminates the program and returns to BASIC.

## HOW THE PROGRAM WORKS

LOGAN is written in a modular fashion and consists of six separate sections, each of which is relatively independent of the others.

The first section, lines 10-70, merely initializes certain parameters and then requests the task number. The appropriate task is then invoked by the computed GOTO statement in line 70.

The next part of the program, lines 1000-1310, allows for specification of the logic circuit. If the circuit is NEW, the array containing the circuit information is cleared (set to zero) before accepting any new information. The array specifying the circuit, referenced by variable C in the program, is a 64 x 8 byte array located at decimal address 1024. Because of the length of the program and the limited amount of memory available on my Apple computer (8K bytes), I had to use the PEEK and POKE features of Apple BASIC. To examine the byte at decimal address A, you merely reference PEEK (A); to deposit a quantity Q into the byte at address A, you use the statement: POKE A,Q. On systems with more memory, the use of PEEK and POKE can be eliminated by using a DIM'd variable. The C array can be thought of as 64 rows of 8 columns each, where the row number corresponds to the gate label. The first of the eight columns indicates the *type* of the gate (AND, NOR, etc.), or a zero if no gate exists with that label. The second column points to the output node in the node array N (see below). The third through eighth columns contain pointers to the input nodes, with zeros serving as filler for those gates having less than six inputs.

The PEEK and POKE functions only treat memory as a linear (one dimensional) array. But the circuit array is a two dimensional array (64 x 8). So I linearize the array by computing any I,J subscript as 8\*I+J (where I ranges from 0 to 63 and J ranges from 0 to 7).

The third part of the program, lines 2000-2090, allows for specification of the initial node states. If the nodes are to be cleared first, they all get assigned the value 255 (undefined) before being reassigned. The array of node states (referenced by variable N) is a 256 byte array located at decimal address 768. Again, because of memory limitations, this array is accessed via PEEK and POKE STATEMENTS. The address of each byte in the node array corresponds to the node label. Each node can exist in one of four states: zero (0), one (1), undefined (255), or undefined (3).

Now we come to the "guts" of the program, lines 3000-3990. Here is where the actual circuit analysis takes place. The process is really quite simple and straightforward. A search is made through the circuit array for those labels which have a gate assigned to them. The states of the input nodes to the gate are examined and compared with the state of the output node. If the output node is currently in a state that is inconsistent with the inputs to the gate, the output node state is changed to the correct state and a flag is set indicating that an output node has changed state. At the end of the search the flag is tested. If no nodes have undergone a change of state, the analysis terminates with the stable node states in the node array. Otherwise, the entire search is repeated until stability is reached. If an oscillating type of circuit is presented to the program e.g., a NOR gate with its output node connected to one of its inputs, the program will never converge on a stable solution and it will iterate forever. So care must be used when analyzing logic circuits with feedback loops in them. (You can have them, but just make sure they're stable.)

The final two parts of the program, lines 4000-4100 and lines 5000-5210, merely tabulate a display of the node array and circuit array, respectively.

The program, as listed here, uses most of the available memory of an 8K Apple-one computer. Consequently, the listing is not very heavily commented. But the program is simple enough so that there should be very little difficulty in understanding it.

## LOGAN PROGRAM LISTING

```

1 REM * LOGIC ANALYSIS PROGRAM *
2 REM WRITTEN BY ROBERT J. BISHOP

10 DIM A(8),R$(22),C$(4)
20 R(1)=1:R(2)=4:R(3)=6:R(4)=
  9:R(5)=13:R(6)=16:R(7)=19:
  R(8)=23
30 R$="ANDORINVNANDNORXNOR"

40 N=768:C=1024
45 PRINT : PRINT "LOGIC ANALYSIS P
PROGRAM"
50 PRINT : PRINT : INPUT "TASK: "
  :P
60 IF R$(P) THEN 50
70 GOTO 1000*(P+3)
100 REM INPUT THE CIRCUIT
1010 INPUT "OLD OR NEW: ",C$
1015 IF C$="OLD" THEN 1040
1020 IF C$="NEW" THEN 1000
1030 FOR K=0 TO 511: POKE C+K,0
  : NEXT K
1040 PRINT : INPUT "LABEL: ",L
1050 IF L<63 THEN 1040
1060 IF L<1 THEN 50
1070 L=0
1080 FOR K=0 TO 7: POKE C+L+K,0
  : NEXT K
1100 INPUT "GATE: ",G$
1110 IF C$="DEL" THEN 1040
1200 G=0
1210 FOR K=1 TO 7
1220 IF C$=R$(G),R$(K+1)-1 THEN
  G=K
1230 NEXT K
1240 IF G=0 THEN 1100
1250 POKE C+L+1,L+1
1300 INPUT "NODE: ",G
1310 IF G THEN 1250: GOTO 1040
1500 REM INPUT THE NODE STATES
2000 INPUT "CLEAR ",C$
2010 IF C$="NO" THEN 2050
2020 IF C$="YES" THEN 2000
2030 FOR K=1 TO 255: POKE N+K,255
  : NEXT K
2050 PRINT : INPUT "NODE: ",G
2060 IF G<1 THEN 50
2070 IF G<35 THEN 2050
2080 INPUT "STATE: ",S
2090 POKE N+G,S: GOTO 2050
2500 REM ANALYZE THE CIRCUIT
3000 I=0
3010 I=I+1: PRINT "ITERATION ",I
3020 T=0
3030 FOR K=1 TO 63
3040 G=PEEK (C+8*K)
3050 IF G=0 THEN 3500
3060 GOTO 3030+5000
3100 Z=0: GOSUB 3900: GOTO 3450
3150 Z=1: GOSUB 3900: GOTO 3450
3200 O=PEEK (N+PEEK (C+8*K+2)
  )
3210 GOSUB 3600: GOTO 3450
3250 Z=0: GOSUB 3900: GOSUB 3600
  : GOTO 3450
3300 Z=1: GOSUB 3900: GOSUB 3600
  : GOTO 3450
3350 GOSUB 3700: GOTO 3450
3400 GOSUB 3700: GOSUB 3600
3450 IF O=PEEK (N+PEEK (C+8*K+
  1)) THEN 3500
3460 I=I: POKE N+PEEK (C+8*K+1)
  :O
  :O

```

```

3500 NEXT K
3550 IF T THEN 3810: GOTO 50
3575 REM INVERTER
3600 IF O1 THEN 3610: O1=1-O1: RETURN

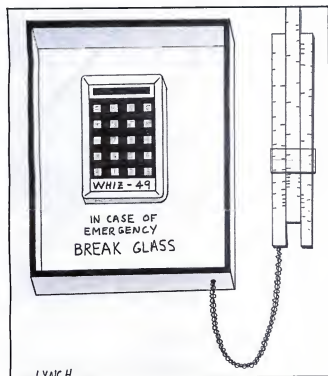
3610 O=257-O: RETURN
3650 REM EXCLUSIVE OR
3700 O1=PEEK (N+PEEK (C+8)*K+2)
3710 O2=PEEK (N+PEEK (C+8)*K+3)
3720 IF O1 AND O2 THEN 3740
3730 O=O1+O2: RETURN
3740 IF O1-1 AND O2-1 THEN 3760

3790 O=O1*O2: GOSUB 3680: RETURN
3760 O=1: IF O1+O2 THEN O=0: RETURN

3800 REM AND & OR
3900 O=1-Z: FOR J=2 TO 7
3910 O1=PEEK (C+8*(K+J))
3920 IF O1=0 THEN 3990: O=PEEK (N+O1)
3930 IF O1=2 THEN 3940: O=2: RETURN
3940 IF O+O1*257 THEN 3990: O=2: RETURN

3990 IF O=1-Z THEN 3990: O=0
3990 NEXT J: RETURN
3995 REM OUTPUT THE NODE STATES
4000 T=1
4010 FOR K=1 TO 255
4020 IF PEEK (N+K)>1 THEN 4100
4030 TRB T: PRINT K: "; PEEK (N+K)
4040 T=T+8: IF T<40 THEN 4100
4050 T=1: PRINT
4100 NEXT K: PRINT : GOTO 50
4500 REM OUTPUT THE CIRCUIT
5000 FOR K=1 TO 51
5010 O=PEEK (C+8*K): IF O=0 THEN 5200
5020 PRINT K: TRB 4
5030 PRINT A$(A$(O),A$(K+1))-1)
5040 T=T+8
5050 FOR J=1 TO 7: O=PEEK (C+8*(K+J))
5060 IF O=0 THEN 5100
5070 TRB T: T=T+4: PRINT G
5100 NEXT J: PRINT
5200 NEXT K
5210 GOTO 50
6000 END

```



## ASC II KEYBOARD NEW LOOK IMPROVED DESIGN



**\$58.00**

This 63 key ASC II Encoded Keyboard kit was designed and manufactured by **Electronics Warehouse Inc.** Features: Single 5 volt D.C. supply, utilizing only TTL Logic elements (no MOS devices to blow). TTL drive capability (each of the eight bits of ASC II output will drive the equivalent of ten standard TTL inputs without external buffer drivers), de-bouncing, upper and lower case fully ASC II, 8 bit parallel. In addition to the alpha-numeric and symbol keys available on a regular keyboard, the following keys are utilized: Escape, back-space, tab, line-feed, delete, control, shift-lock, shift (2 keys), return. All 128 ASC II characters are generated.

Kit includes: 63 key keyboard, P.C. board, all required components and assembly manual with ASC II code list.

Optional: Parity bit - add \$06 • Enclosure - \$25.00 • Serial output - add \$2.00 • 18 Pin edge connector - \$2.00 • Sockets - \$4.00

Note: If you already have this teletype keyboard you can have the kit without it for **\$39.00**. Dealer inquiries invited.

FROM CONCORD

## THE FIRST FULL FEATURE

concord LSI DMM KIT  
INTRODUCTORY PRICE:

**\$77.11**

Reg. Suggested Retail: \$149.00

- AUTO RANGING
- AUTO POLARITY
- AUTO ZERO
- 3 Large Digits (1/2")
- Rechargeable

**MEASUREMENT RANGES:**  
Voltage (AC & DC) 1 mV - 1000V  
Current (AC & DC) 10 uA - 1A  
RESISTANCE 1 Ω - 10 M Ω  
Basic D.C. Accuracy, better than 0.1% ± 1 Digit  
Power: 4 AA batteries (Rechargeable batteries optional)

NI-CAD BATTERIES: \$6.00 • ACCHARGER: \$4.95 • ENCLOSURE: \$12.95 • TEST LEADS: \$1.95 • SHUNT KIT FOR 3 CURRENT RANGES: \$4.75 • SOCKETS \$2.50

### ORDERING INFORMATION

SHIPPING AND HANDLING - \$3.00 + 50% Insurance  
California residents add 6% sales tax

### ELECTRONICS WAREHOUSE Inc.

1603 AVIATION BLVD. Dept. I  
REDONDO BEACH, CA. 90278  
TEL. (213) 376-8005

WRITE FOR FREE CATALOG

You are invited to visit our store at the above address



# Apple Star-Trek

by Robert J. Bishop

APPLE STAR-TREK is an additional version of the "STAR-TREK" type of games in which you must find and shoot down the "bad guys," the Klingons. The rules are very similar to most STAR-TREK games.

## RULES

The galaxy is divided into 64 quadrants arranged in an 8x8 grid; each quadrant is further subdivided into 8x8 sectors. Your mission is to find and destroy the seven Klingon spaceships hiding somewhere in the galaxy; you are allotted 15 stardates and have two starbases at which you can refuel. You are initially supplied with three photon torpedoes and 500 units of energy. Your energy supply is used to (a) move you around the galaxy, (b) fire your phasers, and (c) protect the Enterprise via its deflection shields which are automatically activated by the on-board computer every time a Klingon fires at you.

Each time you enter or maneuver within a quadrant containing a Klingon, he will shoot at you, and the amount of damage his phasers did to your shields will be indicated. Each time you shoot at him with either phasers or photon torpedoes and fail to destroy him, he will also return fire upon you.

## COMMANDS

There are six commands available to you; they are numbered from 0 to 5:

COMMAND	FUNCTION
0	Moves the Enterprise. Computer responds with: "VECTOR ?", to which you must specify the number of sectors you wish to move, both horizontally and vertically. A positive horizontal move is to the right, and a positive vertical move is up. These two vector components must be separated by a comma; for example: -21,35 would move the Enterprise 21 sectors to the left of its current position, and 35 sectors up.
1	Short Range Sensor Scan. Prints the quadrant you are currently in, with the Enterprise represented by the symbols: <'> , Klingons represented by: +++, starbases by: >I< , and stars by: *.
2	Long Range Sensor Scan. Displays a 3x3 array of "nearest neighbor" quadrants with the Enterprise's quadrant in the center. The scan is coded in the form: KBS, where K is the number of Klingons, B is the number of starbases, and S is the number of stars in the quadrant.
3	Fire Phasers. The computer informs you as to how much total energy you have left, and then

waits for you to indicate how much of that energy you want to fire at the enemy. (Note: the closer you are, the more effect your phasers will have on the Klingons, and conversely!)

4 Fire Photon Torpedo. You have no control over the course of the torpedo; the on-board computer automatically aims at the enemy, taking care to avoid hitting any intervening stars or starbases. (Again, the closer you are, the better your chances of hitting the Klingon.)

5 Library Computer. The library computer allows for the following two requests:

REQUEST = Zero: Cumulative record of the results of all previous long-range sensor scans of the galaxy.

REQUEST = Non-zero: Status Report

## EXPENDITURE OF SUPPLIES

Moving from one quadrant to another uses up energy and one stardate. However, movement within a given quadrant uses up only energy.

## RELATIVE POSITIONS CHANGE WITH TIME

Much can happen in a few stardates! Consequently, if you leave a quadrant and then later return, don't expect the Klingons, stars, etc. to still be in the same relative positions that they were in when you left! The number of each will still be the same, but their positions will be different. This means that whenever you enter a new quadrant, you don't know just where the various objects will be; in fact, don't be too surprised if once in a while you collide with things!!!

## REPLENISHMENT OF SUPPLIES

Docking at a starbase re-initializes your supply of photon torpedoes to 3, and your energy supply to 500. Docking is accomplished by moving the Enterprise to any one of the four sectors immediately adjacent a starbase, above, below, left, or right.

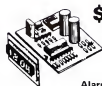
## BATTLE RETREAT

Firing zero units of phaser energy will return you to command mode. This allows you to retreat from battle.

## GALAXY CO-ORDINATE SYSTEM

Quadrant 0,0 is the lower left hand quadrant of the galaxy, and quadrant 7,7 is the upper right. Likewise,

## JUMBO LED CAR CLOCK



**\$16.95**  
KIT

Alarm Option - \$1.50  
AC XFMR - \$1.50

**THE HOTTEST SELLING KIT WE EVER PRODUCED!**  
You requested it! Our first D.C. operated clock kit. Professionally engineered from scratch. Not a makeshift kluge as sold by others. Features:

- Bowmar Jumbo - .5 inch LED array.
- MOSTEK - 50250 - Super Clock Chip.
- On board precision crystal time base.
- 12 or 24 Hr. Real Time Format.
- Perfect for cars, boats, vans, etc.
- P.C. Board and all parts (less case) included.

**50,000 SATISFIED CUSTOMERS CANNOT BE WRONG!**

**THIS MONTH'S SPECIALS**  
AMD - 8080A \$14.95  
Z-80 CPU 49.95  
82S129 1K PROM 2.50

**1702A 2K EPROM**  
We tell it like it is. We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1702 A's in sockets. We carefully removed the parts, verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction guaranteed! U.V. Erasable. **NEW PRICE! \$2.95 ea.** (2.3 US access time)

**UP YOUR COMPUTER!**  
**21L02-1 1K LOW POWER 500 NS**  
**STATIC RAM** Time is of the essence! And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the heat light off for \$12.95

## 60 HZ CRYSTAL TIME BASE S.D. SALES EXCLUSIVE!

**\$5.95 ea.**

**2/\$10.00**

### KIT FEATURES:

- 60Hz output with accuracy comparable to a digital watch.
- Directly interfaces with all MOS clock chips.
- Super low power consumption (1.5 MA typ.)
- Uses latest MOS 17 stage divider IC.
- Eliminates forever the problem of AC line glitches.
- Perfect for cars, boats, campers, or even for portable clocks at ham field days.
- Small size; can be used in existing enclosures. Kit includes Crystal, Driver IC, PC board, plus all necessary parts and specs. At last count - over 20,000 sold!

**1000 MFD Filter Caps**  
Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists. Compare at up to \$1.19 ea. from franchise type electronic parts stores. S.D. Special 4/\$1.

**Slide Switch Assortment**  
Our best seller. Includes miniature and standard sizes; single and multi-position units. All new, first name brand. Try one package and you'll reorder more! Special 12/\$1.00



**RESISTOR ASSORTMENT**  
1/4W 5% & 10% PC leads. A good mix of values. 200/\$2.



### S.D. SALES EXCLUSIVE

**\$12.95 MOS 6 DIGIT UP-DOWN COUNTER \$12.95**  
40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED segment drive, single power supply (1.2 VDC TYPE.), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare output, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking, 1MHz. count input frequency. Very limited quantity! WITH DATA SHEET

7400-19C	7411-29C	7451-19C	7490-65C	74153-75C
74LS00-49C	7413-50C	7453-19C	74LS90-95C	74154-100
7402-19C	7416-9C	7473-39C	7492-75C	74157-75C
74LS02-49C	7420-19C	7474-35C	7493-69C	74161-95C
7404-19C	7430-19C	74LS74-9C	74123-55C	74181-110
74LS04-29C	7432-34C	7475-69C	7496-89C	74165-110
74504-44C	7437-39C	7476-35C	74121-38C	74174-95C
74LS04-49C	7438-39C	7480-49C	74132-170	74181-050
7406-29C	7440-19C	7483-95C	74138-195	74192-125
7408-19C	7447-85C	7485-95C	74138-195	74192-125
7410-19C	7448-85C	7485-95C	74141-75C	74195-69C

**P.C. LEAD DIODES**  
1N4148/1N914  
100/\$2.00  
2N4002/2A  
100 PIV 40/\$1.

**HEAVY DUTY Full Wave Bridge**  
25 AMP 50 PIV  
**\$1.25**

**Disc Cap Assortment**  
PC leads. At least 10 different values. Includes .001, .01, .05, plus other standard values. 50/\$1.00

## \$9.95 KIT

P.C. Board - 3.00  
AC XFMR - 1.50

Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle - avoid the 53141

**SIX DIGIT ALARM CLOCK KIT**  
We made a fantastic kit even better. Redesigned to take advantage of the latest advances in I.C. clock technology. Features: Litronix Dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). P.C.B. or XFMR **NEW! WITH JUMBO LED READOUTS!**

**Motorola SCR**  
2N4443, 8 AMP 400 PIV.  
P.C. Leads 3/\$1.

**FAIRCHILD - TBA 641**  
4W. Audio power Amp. Just out in special heat sink DIP. One super audio IC. \$1.50 with data

**FND-359 - Led Readout**  
.4 IN. Common Cathode. High efficiency. Has FND-70 PIN OUT. 79c

**OUR CATALOG**  
is chocked full of rare parts bargains, deals, RAM or CPU kits, plus much more. Yours FREE!

**PRICES SHOWN SUBJECT TO CHANGE WITHOUT NOTICE.**



**\$15.95**

**COMPUTER POWER SUPPLY**  
A very fortunate purchase. One of the best industrial quality REGULATED supplies we have seen. High performance, small size. Input is 120 VAC 60 HZ. Has the following regulated outputs: -5VDC@800MA; -15VDC @ 1.25 AMP; -25VDC @ 180 MA. Sold at a fraction of original cost. Do yourself a favor and order NOW. We expect a quick sellout.

**AMD - 1702A**  
Factory Prime Units. Brand New.  
1.5 micro-seconds access time.  
**\$4.95 each. HUGE FACTORY DIRECT PURCHASE!**

Call your BankAmericard or Master Charge order in on our continental United States toll free Watts:  
**1-800-527-3460**  
Texas Residents Call Collect:  
**214/271-0022**

Special Thanks to:  
Dennis, Fred, Abe, Bill, Sam, Hal, Tom, Alax, John, Ely, and Larry  
**S.D. SALES CO.**  
P.O. BOX 28810  
Dallas, Texas 75228

sector 0,0 is in the lower left hand corner of the quadrant and 7.7 in the upper right. (Thus, the galaxy resembles a Cartesian co-ordinate system with the x-axis pointing to the right, and the y-axis pointing up.)

### PROGRAM MODIFICATIONS

The APPLE STAR-TREK program is written in APPLE BASIC and uses most of the available memory. Any attempts to expand or modify the program are done at your own risk!

## Program Listing

```

20 DIM C$(16),DR$(15)
21 GO=640:SY=704:DB=" "
22
23 INPUT "TYPE A NUMBER ",R
24 FOR J=1 TO R C=R:DB=" "
25 NEXT
26
27 GO=5175:GOUSE 1100
28 S=5175-N*51:VH=L*H:GOUSE
29 1300
30 BLK=NHL:VH=L*H:GOUSE
31 1300
32 CL=7:VH=L*H:GOUSE 1300
33
34 GO=115:GOUSE 1300:GO=H*H:
35 4050:1:GOUSE 1400:GOUSE 1500
36
37 PRINT INPUT "COMMAND ",C
38 IF C=O OR C=J THEN I=1:GO 110
39 ELSE I=200
40 INPUT "VECTOR ",X,V,Y:V=V*H
41 X=V*H*V*H:Y=V*H*H:Z=O:RES=O
42
43 IF X=O OR Y=O OR Z=O OR V=O OR
44 W=O THEN I=1:GO 110
45 ELSE GO=5544:GOUSE 5100:GOUSE
46 1400:IF O=O THEN I=200
47 ELSE I=25:W=1+I:GOUSE 250
48
49 GO=5544:GOUSE 1400:IF T=O THEN
50 260
51
52 C#="TIME":GO 700
53 C#="CALC":GO 900
54
55 FOR C=545:O:GOUSE 950
56 GOUSE 150:IF R=2 THEN THEN 250
57
58 IF RES C=545+O:RES C=V*
59 V*H:THEN 250
60
61 PRINT "BOCIES "*,I
62
63 FOR PORE=O:GOUSE 400:O=O
64
65 PORE=S*O*V*V*O:GO 110
66
67 IF K=O THEN GOUSE 550:GO 110
68
69 C#="SORPT":GOUSE 350:GOUSE
70 360
71
72 PRINT C#,"RANGE SENSOR SOM"
73 GOUSE 360:RETURN
74
75 PRINT "FOR CURRENT ",X,I,"
76 V,I
77
78 C#="LOW":GOUSE 350:W=O:GOUSE
79 800
80
81 FOR V=V+1 TO V=I+1 STEP 1
82 W=O:IF V=O OR V=I THEN
83 PRINT C#,"OUSE 450
84
85 FOR W=O+1 TO W=I+1:IF
86 W=O THEN
87 FOR F=O:W:GOUSE 700:THEN 440
88 PRINT C#,"GO 400
89
90 GOUSE 450:GOUSE 1400:GOUSE
91 600:GOUSE 400:PRINT "X",I*Z
92
93 NEXT V:PRINT "X",GOUSE 450
94
95 NEXT V:GOUSE 470:GOUSE
96 810:GO 110
97
98 C#="":GOUSE 1600:RETURN
99
100 C#="":GOUSE 1600:RETURN
101
102 IF K=O THEN GOUSE 750
103 PRINT "CHECK ",I:INPUT
104 "FIRE ",C:IF C=I THEN I=1:GO
105 110
106
107 ELSE I=O:GOUSE 1400:K=5+5:
108 C=I:IF I=O THEN 350:GOUSE
109 1500:GO 110
110
111 GOUSE 550:GO 580
112
113 S=5145+5:K=5+5:ELSE I=5:
114 GOUSE 550:GOUSE 550:IF PAGER
115 D=O:GOUSE 1000:RETURN
116
117 IF K=O THEN GOUSE 600:IF T=O THEN
118 GO 110
119
120 ELSE I=O:IF K=O:K=5:THEN
121 GOUSE 1500:GO 110
122
123 IF K=O:K=5:GOUSE 550:GOUSE
124 550:GO 110
125
126 INPUT "COMPUTER REQUEST ",
127 IF C=O THEN 500
128
129 PRINT "SYSTEM REPORT":PRINT
130
131 GOUSE 750:PRINT "KLINGING":
132
133 GOUSE 750:PRINT "STROBATES":
134
135 GOUSE 750:PRINT "STARBURSTS":
136
137 GOUSE 750:PRINT "TORPEDES":
138
139 GOUSE 750:PRINT "ENERGY":
140
141
142 GO 110
143
144 PRINT "REKLING":RETURN
145
146 PRINT "ALPHAC PRP":PRINT
147
148 GOUSE 260:IF C="":
149
150 GOUSE 600:FOR V=O TO 5 STEP
151 1:GO 110
152
153 FOR P=O TO 2:GO=H*V:GOUSE
154 150:PEEK (O+V)
155
156 IF P=2 THEN THEN 440:PRINT "X",
157 I:GO 550
158
159 PRINT "X",I*Z:50
160
161 NEXT V:PRINT
162
163 NEXT V:GOUSE 1600:GOUSE
164 810:GO 110
165
166 GOUSE 600:K=4:RETURN
167
168 K=4:GOUSE 720:RETURN
169
170 PRINT "OUT - OUT OF
171 "*,I
172
173 PRINT "YOU LEFT ",I," KLINGING":
174 END
175
176 GOUSE 1100:GOUSE 400:GOUSE
177 150
178
179 PORE=O:GOUSE 400:GOUSE
180
181 W=V*L*V:GOUSE 1200
182
183 W=V*L*V:GOUSE 1200:K=5+5:
184 V=L*V:V=L*V:V=L*V
185
186 W=V*L*V:GOUSE 1200:V=L*V:
187 V=L*V:V=L*V:V=L*V
188
189 C#="PEAK":IF K=O THEN GOUSE
190 "PEAK":PRINT "STROBATE
191 ",I*Z*V*V,": COLLISION "*,
192 I
193
194 PRINT "BOCERPT ",X,I,"V,I
195
196 C#="SECTOR":I=I+1:V=I
197
198 P#="SECTOR":I=I+1:V=I
199
200 P#="PEAK":GOUSE 450:
201
202 PRINT "COLLISION M",
203 I
204
205 IF P# THEN PRINT "STAR":
206
207 IF P# THEN PRINT "STARBURST":
208
209 IF P# THEN PRINT "KLINGING":
210
211
212 PRINT "X":IF P# THEN
213 ELSE:GOUSE 550
214
215 IF K=O THEN GOUSE 600:GOUSE
216 150:GOUSE 400:GOUSE 400:GOUSE
217 150:GOUSE 400:GOUSE 400:GOUSE
218 150:GOUSE 400:GOUSE 400:GOUSE
219 150:GOUSE 400:GOUSE 400:GOUSE
220
221 GOUSE 400:GOUSE 400:GOUSE 400:
222 GOUSE 400:GOUSE 400:GOUSE 400:
223 GOUSE 400:GOUSE 400:GOUSE 400:
224 GOUSE 400:GOUSE 400:GOUSE 400:
225 GOUSE 400:GOUSE 400:GOUSE 400:
226 GOUSE 400:GOUSE 400:GOUSE 400:
227 GOUSE 400:GOUSE 400:GOUSE 400:
228 GOUSE 400:GOUSE 400:GOUSE 400:
229 GOUSE 400:GOUSE 400:GOUSE 400:
230 GOUSE 400:GOUSE 400:GOUSE 400:
231 GOUSE 400:GOUSE 400:GOUSE 400:
232 GOUSE 400:GOUSE 400:GOUSE 400:
233 GOUSE 400:GOUSE 400:GOUSE 400:
234 GOUSE 400:GOUSE 400:GOUSE 400:
235 GOUSE 400:GOUSE 400:GOUSE 400:
236 GOUSE 400:GOUSE 400:GOUSE 400:
237 GOUSE 400:GOUSE 400:GOUSE 400:
238 GOUSE 400:GOUSE 400:GOUSE 400:
239 GOUSE 400:GOUSE 400:GOUSE 400:
240 GOUSE 400:GOUSE 400:GOUSE 400:
241 GOUSE 400:GOUSE 400:GOUSE 400:
242 GOUSE 400:GOUSE 400:GOUSE 400:
243 GOUSE 400:GOUSE 400:GOUSE 400:
244 GOUSE 400:GOUSE 400:GOUSE 400:
245 GOUSE 400:GOUSE 400:GOUSE 400:
246 GOUSE 400:GOUSE 400:GOUSE 400:
247 GOUSE 400:GOUSE 400:GOUSE 400:
248 GOUSE 400:GOUSE 400:GOUSE 400:
249 GOUSE 400:GOUSE 400:GOUSE 400:
250 GOUSE 400:GOUSE 400:GOUSE 400:
251 GOUSE 400:GOUSE 400:GOUSE 400:
252 GOUSE 400:GOUSE 400:GOUSE 400:
253 GOUSE 400:GOUSE 400:GOUSE 400:
254 GOUSE 400:GOUSE 400:GOUSE 400:
255 GOUSE 400:GOUSE 400:GOUSE 400:
256 GOUSE 400:GOUSE 400:GOUSE 400:
257 GOUSE 400:GOUSE 400:GOUSE 400:
258 GOUSE 400:GOUSE 400:GOUSE 400:
259 GOUSE 400:GOUSE 400:GOUSE 400:
260 GOUSE 400:GOUSE 400:GOUSE 400:
261 GOUSE 400:GOUSE 400:GOUSE 400:
262 GOUSE 400:GOUSE 400:GOUSE 400:
263 GOUSE 400:GOUSE 400:GOUSE 400:
264 GOUSE 400:GOUSE 400:GOUSE 400:
265 GOUSE 400:GOUSE 400:GOUSE 400:
266 GOUSE 400:GOUSE 400:GOUSE 400:
267 GOUSE 400:GOUSE 400:GOUSE 400:
268 GOUSE 400:GOUSE 400:GOUSE 400:
269 GOUSE 400:GOUSE 400:GOUSE 400:
270 GOUSE 400:GOUSE 400:GOUSE 400:
271 GOUSE 400:GOUSE 400:GOUSE 400:
272 GOUSE 400:GOUSE 400:GOUSE 400:
273 GOUSE 400:GOUSE 400:GOUSE 400:
274 GOUSE 400:GOUSE 400:GOUSE 400:
275 GOUSE 400:GOUSE 400:GOUSE 400:
276 GOUSE 400:GOUSE 400:GOUSE 400:
277 GOUSE 400:GOUSE 400:GOUSE 400:
278 GOUSE 400:GOUSE 400:GOUSE 400:
279 GOUSE 400:GOUSE 400:GOUSE 400:
280 GOUSE 400:GOUSE 400:GOUSE 400:
281 GOUSE 400:GOUSE 400:GOUSE 400:
282 GOUSE 400:GOUSE 400:GOUSE 400:
283 GOUSE 400:GOUSE 400:GOUSE 400:
284 GOUSE 400:GOUSE 400:GOUSE 400:
285 GOUSE 400:GOUSE 400:GOUSE 400:
286 GOUSE 400:GOUSE 400:GOUSE 400:
287 GOUSE 400:GOUSE 400:GOUSE 400:
288 GOUSE 400:GOUSE 400:GOUSE 400:
289 GOUSE 400:GOUSE 400:GOUSE 400:
290 GOUSE 400:GOUSE 400:GOUSE 400:
291 GOUSE 400:GOUSE 400:GOUSE 400:
292 GOUSE 400:GOUSE 
```

# JOHN CONWAY'S GAME OF LIFE

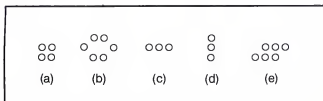
Programmed by Alan R. Miller

## INTRODUCTION

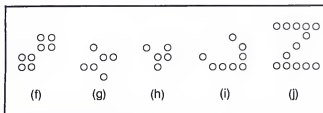
John Conway's game of life is described in Scientific American October 1970 and February 1971, and in such collections as *101 Basic Games* and *What To Do After You Hit Return*. Life deals with the life and death of counters which may be likened to living organisms, on a rectangular grid of cells. Counters are placed in various cells and the game begins. Each counter can have a maximum of eight neighbors: UP, DOWN, LEFT, RIGHT and the four DIAGONALS. Those with exactly two or three neighbors survive until the next generation. Those with more, "die" of overpopulation (are removed), and those with less, "die" of isolation. An empty cell with exactly three neighbors becomes a birth cell (a counter appears), otherwise it remains an empty cell for the next generation. Some groups of counters form patterns that are stable, others form patterns that oscillate or that disappear altogether.

## LIFE PATTERNS

Two stable patterns are a "block" (a) and a "beehive" (b).



Three horizontal counters produce a "blinker" (c) that alternately changes to three vertical counters (d). Five horizontal counters produce four sets of blinkers and ten horizontal counters generate a repeating series of 15 patterns. Other blinkers will be formed from the "frog" (e), the "beacon" (f) and the "clock" (g).



A "glider" is a sequence of patterns that continually repeat, but move along in the process. The initial patterns shown in (h) and (i) produce gliders that respectively move downward and to the right. A five-by-five Z (j) will produce two such gliders moving off in opposite directions. Single diagonal rows called "fuses" lose the two end members each generation until all have disappeared (burned up). "Capping" one end makes it stable and starting with various configurations at the other end results in "dirty" fuses that spew out all sorts of things.

The Scientific American articles describe many other patterns such as glider guns that regularly eject gliders, glider eaters that gobble them up, and a Cheshire cat that slowly disappears first to a grin then to just a paw print.

## MEMORY REQUIREMENTS

LIFE requires 420 bytes of memory including stack space plus 1024 bytes of work space in addition to the VDM memory. The object program is assembled for 5400 to 55AC Hex (52000 to 52654 Octal) with a work space from 5600 to 59FF Hex (53000 to 54777 Octal). The following locations may need to be changed to suit your VDM address, keyboard address, and others.

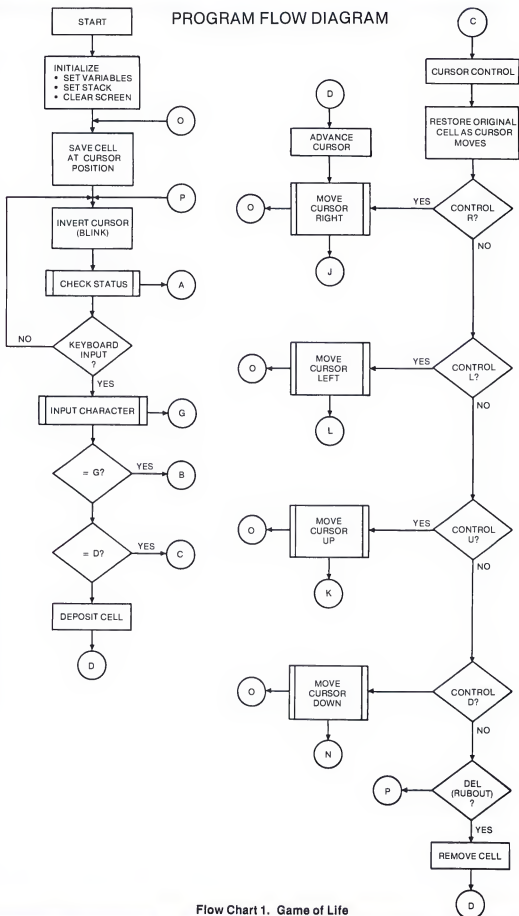
	Address (Hex)	Data (Hex)
Define stack	5401,2	55AC
Define work space	5525,7	5600
Keyboard status address	5461	10
Keyboard data address	5466	11
Data-available mask	5463	01
Jump (not) zero	544B, 5563,	CA
	5596	
VDM port address	542F	C8
VDM memory (start)	5404,5; 5523,4;	F400
	554B,C	
VDM memory (high byte)	551B	F4
VDM top + 1 (high byte)	5512	F8
VDM memory (center)	5436,7	F61F
Return on Control-X	546C,D	0000

## MICROCOMPUTER CONFIGURATION LIFE OBJECT CODE DUMP

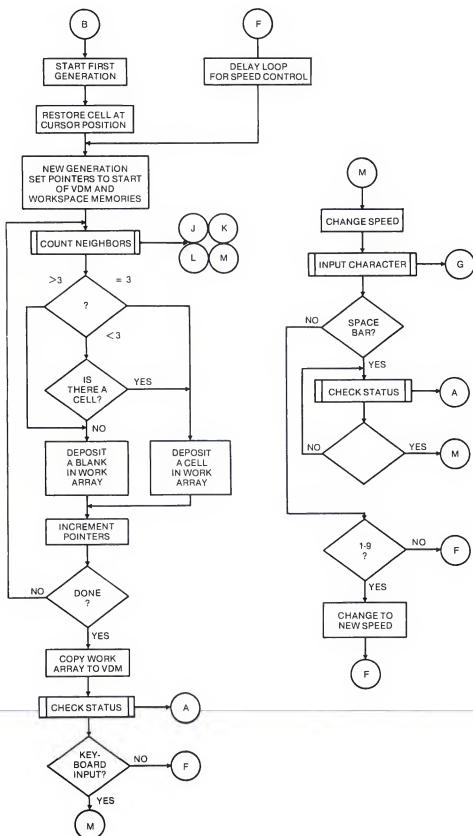
The present program is written for an Altair with a keyboard at 2021 octal. A processor technology VDM addressed to F4 hex (172000Q), with a port address of C8 hex (310Q). The program is executed from the beginning (124-000). A cursor appearing in the center of the screen can be controlled with the following commands:

### LOWING COMMANDS:

CONTROL-R	CURSOR RIGHT
CONTROL-L	CURSOR LEFT
CONTROL-U	CURSOR UP
CONTROL-D	CURSOR DOWN
D	DEPOSIT A CELL (CURSOR MOVES TO RIGHT)
G	(GO), START WHEN ALL CELLS DEPOSITED
DEL (RUBOUT)	DELETE A CELL
CONTROL-K	CLEAR SCREEN
CONTROL-X	JUMP ELSEWHERE (E.G. ADDRESS 0)

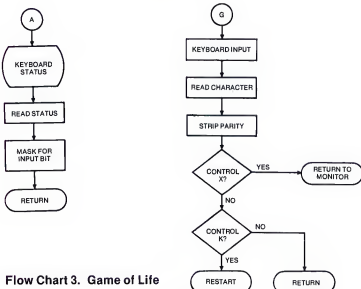
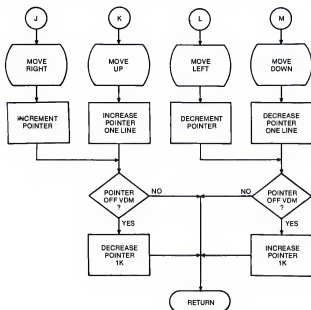


Flow Chart 1. Game of Life



Flow Chart 2. Game of Life





Flow Chart 3. Game of Life

## PROGRAM SOURCE LISTING

```

1  ITHF GAME OF LIFE PROGRAMMED FOR A
2  IPROCESSOR TECHNOLOGY VIDEO DISPLAY MODULE
3  I
4  IRY ALAN R. MILLER
5  I
6  I
7  I
8  IINFS 40H BYTES PLUS 1024 BYTES OF WORK SPACE
9  I ASSUMES PCD VDM IS ADDRESS80 TO FANIN
10 I I WITH POINT AT CHM AND A KEYBOARD AT 10H (20H)
11 I
12 I
13 I
14 I
15 I
16 I
17 I
18 I
19 I
20 I
21 I
22 I
23 I
24 I
25 I
26 I
27 I
28 I
29 I
30 I
31 I
32 I
33 I
34 I
35 I
36 I
37 I
38 I
39 I
40 I
41 I
42 I
43 I
44 I
45 I
46 I
47 I
48 I
49 I
50 I
51 I
52 I
53 I
54 I
55 I
56 I
57 I
58 I
59 I
60 I
61 I
62 I
63 I
64 I
65 I
66 I
67 I
68 I
69 I
70 I
71 I
72 I
73 I
74 I
75 I
76 I
77 I
78 I
79 I
80 I
81 I
82 I
83 I
84 I
85 I
86 I
87 I
88 I
89 I
90 I
91 I
92 I
93 I
94 I
95 I
96 I
97 I
98 I
99 I
100 I
101 I
102 I
103 I
104 I
105 I
106 I
107 I
108 I
109 I
110 I
111 I
112 I
113 I
114 I
115 I
116 I
117 I
118 I
119 I
120 I
121 I
122 I
123 I
124 I
125 I
126 I
127 I
128 I
129 I
130 I
131 I
132 I
133 I
134 I
135 I
136 I
137 I
138 I
139 I
140 I
141 I
142 I
143 I
144 I
145 I
146 I
147 I
148 I
149 I
150 I
151 I
152 I
153 I
154 I
155 I
156 I
157 I
158 I
159 I
160 I
161 I
162 I
163 I
164 I
165 I
166 I
167 I
168 I
169 I
170 I
171 I
172 I
173 I
174 I
175 I
176 I
177 I
178 I
179 I
180 I
181 I
182 I
183 I
184 I
185 I
186 I
187 I
188 I
189 I
190 I
191 I
192 I
193 I
194 I
195 I
196 I
197 I
198 I
199 I
200 I
201 I
202 I
203 I
204 I
205 I
206 I
207 I
208 I
209 I
210 I
211 I
212 I
213 I
214 I
215 I
216 I
217 I
218 I
219 I
220 I
221 I
222 I
223 I
224 I
225 I
226 I
227 I
228 I
229 I
230 I
231 I
232 I
233 I
234 I
235 I
236 I
237 I
238 I
239 I
240 I
241 I
242 I
243 I
244 I
245 I
246 I
247 I
248 I
249 I
250 I
251 I
252 I
253 I
254 I
255 I
256 I
257 I
258 I
259 I
260 I
261 I
262 I
263 I
264 I
265 I
266 I
267 I
268 I
269 I
270 I
271 I
272 I
273 I
274 I
275 I
276 I
277 I
278 I
279 I
280 I
281 I
282 I
283 I
284 I
285 I
286 I
287 I
288 I
289 I
290 I
291 I
292 I
293 I
294 I
295 I
296 I
297 I
298 I
299 I
300 I
301 I
302 I
303 I
304 I
305 I
306 I
307 I
308 I
309 I
310 I
311 I
312 I
313 I
314 I
315 I
316 I
317 I
318 I
319 I
320 I
321 I
322 I
323 I
324 I
325 I
326 I
327 I
328 I
329 I
330 I
331 I
332 I
333 I
334 I
335 I
336 I
337 I
338 I
339 I
340 I
341 I
342 I
343 I
344 I
345 I
346 I
347 I
348 I
349 I
350 I
351 I
352 I
353 I
354 I
355 I
356 I
357 I
358 I
359 I
360 I
361 I
362 I
363 I
364 I
365 I
366 I
367 I
368 I
369 I
370 I
371 I
372 I
373 I
374 I
375 I
376 I
377 I
378 I
379 I
380 I
381 I
382 I
383 I
384 I
385 I
386 I
387 I
388 I
389 I
390 I
391 I
392 I
393 I
394 I
395 I
396 I
397 I
398 I
399 I
400 I
401 I
402 I
403 I
404 I
405 I
406 I
407 I
408 I
409 I
410 I
411 I
412 I
413 I
414 I
415 I
416 I
417 I
418 I
419 I
420 I
421 I
422 I
423 I
424 I
425 I
426 I
427 I
428 I
429 I
430 I
431 I
432 I
433 I
434 I
435 I
436 I
437 I
438 I
439 I
440 I
441 I
442 I
443 I
444 I
445 I
446 I
447 I
448 I
449 I
450 I
451 I
452 I
453 I
454 I
455 I
456 I
457 I
458 I
459 I
460 I
461 I
462 I
463 I
464 I
465 I
466 I
467 I
468 I
469 I
470 I
471 I
472 I
473 I
474 I
475 I
476 I
477 I
478 I
479 I
480 I
481 I
482 I
483 I
484 I
485 I
486 I
487 I
488 I
489 I
490 I
491 I
492 I
493 I
494 I
495 I
496 I
497 I
498 I
499 I
500 I
501 I
502 I
503 I
504 I
505 I
506 I
507 I
508 I
509 I
510 I
511 I
512 I
513 I
514 I
515 I
516 I
517 I
518 I
519 I
520 I
521 I
522 I
523 I
524 I
525 I
526 I
527 I
528 I
529 I
530 I
531 I
532 I
533 I
534 I
535 I
536 I
537 I
538 I
539 I
540 I
541 I
542 I
543 I
544 I
545 I
546 I
547 I
548 I
549 I
550 I
551 I
552 I
553 I
554 I
555 I
556 I
557 I
558 I
559 I
560 I
561 I
562 I
563 I
564 I
565 I
566 I
567 I
568 I
569 I
570 I
571 I
572 I
573 I
574 I
575 I
576 I
577 I
578 I
579 I
580 I
581 I
582 I
583 I
584 I
585 I
586 I
587 I
588 I
589 I
590 I
591 I
592 I
593 I
594 I
595 I
596 I
597 I
598 I
599 I
600 I
601 I
602 I
603 I
604 I
605 I
606 I
607 I
608 I
609 I
610 I
611 I
612 I
613 I
614 I
615 I
616 I
617 I
618 I
619 I
620 I
621 I
622 I
623 I
624 I
625 I
626 I
627 I
628 I
629 I
630 I
631 I
632 I
633 I
634 I
635 I
636 I
637 I
638 I
639 I
640 I
641 I
642 I
643 I
644 I
645 I
646 I
647 I
648 I
649 I
650 I
651 I
652 I
653 I
654 I
655 I
656 I
657 I
658 I
659 I
660 I
661 I
662 I
663 I
664 I
665 I
666 I
667 I
668 I
669 I
670 I
671 I
672 I
673 I
674 I
675 I
676 I
677 I
678 I
679 I
680 I
681 I
682 I
683 I
684 I
685 I
686 I
687 I
688 I
689 I
690 I
691 I
692 I
693 I
694 I
695 I
696 I
697 I
698 I
699 I
700 I
701 I
702 I
703 I
704 I
705 I
706 I
707 I
708 I
709 I
710 I
711 I
712 I
713 I
714 I
715 I
716 I
717 I
718 I
719 I
720 I
721 I
722 I
723 I
724 I
725 I
726 I
727 I
728 I
729 I
730 I
731 I
732 I
733 I
734 I
735 I
736 I
737 I
738 I
739 I
740 I
741 I
742 I
743 I
744 I
745 I
746 I
747 I
748 I
749 I
750 I
751 I
752 I
753 I
754 I
755 I
756 I
757 I
758 I
759 I
760 I
761 I
762 I
763 I
764 I
765 I
766 I
767 I
768 I
769 I
770 I
771 I
772 I
773 I
774 I
775 I
776 I
777 I
778 I
779 I
780 I
781 I
782 I
783 I
784 I
785 I
786 I
787 I
788 I
789 I
790 I
791 I
792 I
793 I
794 I
795 I
796 I
797 I
798 I
799 I
800 I
801 I
802 I
803 I
804 I
805 I
806 I
807 I
808 I
809 I
810 I
811 I
812 I
813 I
814 I
815 I
816 I
817 I
818 I
819 I
820 I
821 I
822 I
823 I
824 I
825 I
826 I
827 I
828 I
829 I
830 I
831 I
832 I
833 I
834 I
835 I
836 I
837 I
838 I
839 I
840 I
841 I
842 I
843 I
844 I
845 I
846 I
847 I
848 I
849 I
850 I
851 I
852 I
853 I
854 I
855 I
856 I
857 I
858 I
859 I
860 I
861 I
862 I
863 I
864 I
865 I
866 I
867 I
868 I
869 I
870 I
871 I
872 I
873 I
874 I
875 I
876 I
877 I
878 I
879 I
880 I
881 I
882 I
883 I
884 I
885 I
886 I
887 I
888 I
889 I
890 I
891 I
892 I
893 I
894 I
895 I
896 I
897 I
898 I
899 I
900 I
901 I
902 I
903 I
904 I
905 I
906 I
907 I
908 I
909 I
910 I
911 I
912 I
913 I
914 I
915 I
916 I
917 I
918 I
919 I
920 I
921 I
922 I
923 I
924 I
925 I
926 I
927 I
928 I
929 I
930 I
931 I
932 I
933 I
934 I
935 I
936 I
937 I
938 I
939 I
940 I
941 I
942 I
943 I
944 I
945 I
946 I
947 I
948 I
949 I
950 I
951 I
952 I
953 I
954 I
955 I
956 I
957 I
958 I
959 I
960 I
961 I
962 I
963 I
964 I
965 I
966 I
967 I
968 I
969 I
970 I
971 I
972 I
973 I
974 I
975 I
976 I
977 I
978 I
979 I
980 I
981 I
982 I
983 I
984 I
985 I
986 I
987 I
988 I
989 I
990 I
991 I
992 I
993 I
994 I
995 I
996 I
997 I
998 I
999 I
1000 I

```

## SOFTWARE SECTION

```

43 5438 46 NUNCKI MOV B,M ;SAVE CURRENT CELL IN R
44 5439 11AB00 RLINCL LRI B,M ;RLINE SPEED
45 543C 3E00 MOV A,B,M ;TURN ON LEFT BIT
46 543E RA ADD H ;INVERT CELL
47 543F 77 MOV M,A ;
48 5440 15 DELAY: DCR 0 ;RLINE TIMING
49 5441 C04854 JNZ DELAY
50 5444 10 E ;
51 5445 C04854 JNZ DELAY
52 5446 C04054 CALL STATUS ;KEYBOARD INPUT
53 5448 C4A954 JZ RLINL INO ;
54 5449 C4D554 CALL INPUT ;IN GET IT
55 5451 FE47 "C" CPJ "C" ;IS IT A C (FROM G0)?
56 5453 C4D555 JZ 0 ;YES, START THE GAME
57 5454 FE46 "Q" CPJ "Q" ;A Q (FROM DEPOSIT)?
58 5456 C07546 JNZ CRIGT ;
59 5458 264F MOV M,T0BN ;MOVE CUBOR RIGHT
60 5459 C37546 JNZ CRJ ;
61 5460 5460 0 ;
62 5461 0 ;SUBROUTINE TO CHECK KEYBOARD-INPUT STATUS
63 5462 0 ;
64 5463 0 ;STATUS: IN TSTAT ;CHECK KEYBOARD STATUS
65 5464 FE41 ANI INMASK ;INMASK UNWANTED BITS
66 5465 C9 JZ RET
67 5466 0 ;
68 5467 0 ;SUBROUTINE TO INPUT DATA FROM KEYBOARD
69 5468 0 ;
70 5469 0 ;INPUT: IN TSTAT ;KEYBOARD DATA POINT
71 546F FE1F ANI TSTAT ;INPUT PARITY
72 5469 FF1F CTRJ ;RETURN ON
73 546B C4B05B JZ ;RETURN ;CONTROL X
74 546C FF0B CTRJ ;IF A ;CLEAR SCREEN AND
75 546E C4B05B JZ ;START ;START ON CONTROL X
76 5473 C9 JZ RET
77 5474 0 ;
78 5475 0 ;CHECK FOR CURSOR MOVEMENTS
79 5476 0 ;
80 5477 0 ;
81 5478 0 ;
82 5479 0 ;
83 547A 0 ;
84 547B 0 ;
85 547C 0 ;
86 547D 0 ;
87 547E 0 ;
88 547F 0 ;
89 5480 0 ;
90 5481 0 ;
91 5482 0 ;
92 5483 0 ;
93 5484 0 ;
94 5485 0 ;
95 5486 0 ;
96 5487 0 ;
97 5488 0 ;
98 5489 0 ;
99 548A 0 ;
100 548B 0 ;
101 548C 0 ;
102 548D 0 ;
103 548E 0 ;
104 548F 0 ;
105 5490 0 ;
106 5491 0 ;
107 5492 0 ;
108 5493 0 ;
109 5494 0 ;
110 5495 0 ;
111 5496 0 ;
112 5497 0 ;
113 5498 0 ;
114 5499 0 ;
115 549A 0 ;
116 549B 0 ;
117 549C 0 ;
118 549D 0 ;
119 549E 0 ;
120 549F 0 ;
121 54A0 0 ;
122 54A1 0 ;
123 54A2 0 ;
124 54A3 0 ;
125 54A4 0 ;
126 54A5 0 ;
127 54A6 0 ;
128 54A7 0 ;
129 54A8 0 ;
130 54A9 0 ;
131 54AA 0 ;
132 54AB 0 ;
133 54AC 0 ;
134 54AD 0 ;
135 54AE 0 ;
136 54AF 0 ;
137 54B0 0 ;
138 54B1 0 ;
139 54B2 0 ;
140 54B3 0 ;
141 54B4 0 ;
142 54B5 0 ;
143 54B6 0 ;
144 54B7 0 ;
145 54B8 0 ;
146 54B9 0 ;
147 54BA 0 ;
148 54BB 0 ;
149 54BC 0 ;
150 54BD 0 ;
151 54BE 0 ;
152 54BF 0 ;
153 54C0 0 ;
154 54C1 0 ;
155 54C2 0 ;
156 54C3 0 ;
157 54C4 0 ;
158 54C5 0 ;
159 54C6 0 ;
160 54C7 0 ;
161 54C8 0 ;
162 54C9 0 ;
163 54CA 0 ;
164 54CB 0 ;
165 54CC 0 ;
166 54CD 0 ;
167 54CE 0 ;
168 54CF 0 ;
169 54D0 0 ;
170 54D1 0 ;
171 54D2 0 ;
172 54D3 0 ;
173 54D4 0 ;
174 54D5 0 ;
175 54D6 0 ;
176 54D7 0 ;
177 54D8 0 ;
178 54D9 0 ;
179 54DA 0 ;
180 54DB 0 ;
181 54DC 0 ;
182 54DD 0 ;
183 54DE 0 ;
184 54DF 0 ;
185 54E0 0 ;
186 54E1 0 ;
187 54E2 0 ;
188 54E3 0 ;
189 54E4 0 ;
190 54E5 0 ;
191 54E6 0 ;
192 54E7 0 ;
193 54E8 0 ;
194 54E9 0 ;
195 54EA 0 ;
196 54EB 0 ;
197 54EC 0 ;
198 54ED 0 ;
199 54EE 0 ;
200 54EF 0 ;
201 54F0 0 ;
202 54F1 0 ;
203 54F2 0 ;
204 54F3 0 ;
205 54F4 0 ;
206 54F5 0 ;
207 54F6 0 ;
208 54F7 0 ;
209 54F8 0 ;
210 54F9 0 ;
211 54FA 0 ;
212 54FB 0 ;
213 54FC 0 ;
214 54FD 0 ;
215 54FE 0 ;
216 54FF 0 ;
217 5400 0 ;
218 5401 0 ;
219 5402 0 ;
220 5403 0 ;
221 5404 0 ;
222 5405 0 ;
223 5406 0 ;
224 5407 0 ;
225 5408 0 ;
226 5409 0 ;
227 540A 0 ;
228 540B 0 ;
229 540C 0 ;
230 540D 0 ;
231 540E 0 ;
232 540F 0 ;
233 5410 0 ;
234 5411 0 ;
235 5412 0 ;
236 5413 0 ;
237 5414 0 ;
238 5415 0 ;
239 5416 0 ;
240 5417 0 ;
241 5418 0 ;
242 5419 0 ;
243 541A 0 ;
244 541B 0 ;
245 541C 0 ;
246 541D 0 ;
247 541E 0 ;
248 541F 0 ;
249 5420 0 ;
250 5421 0 ;
251 5422 0 ;
252 5423 0 ;
253 5424 0 ;
254 5425 0 ;
255 5426 0 ;
256 5427 0 ;
257 5428 0 ;
258 5429 0 ;
259 542A 0 ;
260 542B 0 ;
261 542C 0 ;
262 542D 0 ;
263 542E 0 ;
264 542F 0 ;
265 5430 0 ;
266 5431 0 ;
267 5432 0 ;
268 5433 0 ;
269 5434 0 ;
270 5435 0 ;
271 5436 0 ;
272 5437 0 ;
273 5438 0 ;
274 5439 0 ;
275 543A 0 ;
276 543B 0 ;
277 543C 0 ;
278 543D 0 ;
279 543E 0 ;
280 543F 0 ;
281 5440 0 ;
282 5441 0 ;
283 5442 0 ;
284 5443 0 ;
285 5444 0 ;
286 5445 0 ;
287 5446 0 ;
288 5447 0 ;
289 5448 0 ;
290 5449 0 ;
291 544A 0 ;
292 544B 0 ;
293 544C 0 ;
294 544D 0 ;
295 544E 0 ;
296 544F 0 ;
297 5450 0 ;
298 5451 0 ;
299 5452 0 ;
300 5453 0 ;
301 5454 0 ;
302 5455 0 ;
303 5456 0 ;
304 5457 0 ;
305 5458 0 ;
306 5459 0 ;
307 545A 0 ;
308 545B 0 ;
309 545C 0 ;
310 545D 0 ;
311 545E 0 ;
312 545F 0 ;
313 5460 0 ;
314 5461 0 ;
315 5462 0 ;
316 5463 0 ;
317 5464 0 ;
318 5465 0 ;
319 5466 0 ;
320 5467 0 ;
321 5468 0 ;
322 5469 0 ;
323 546A 0 ;
324 546B 0 ;
325 546C 0 ;
326 546D 0 ;
327 546E 0 ;
328 546F 0 ;
329 5470 0 ;
330 5471 0 ;
331 5472 0 ;
332 5473 0 ;
333 5474 0 ;
334 5475 0 ;
335 5476 0 ;
336 5477 0 ;
337 5478 0 ;
338 5479 0 ;
339 547A 0 ;
340 547B 0 ;
341 547C 0 ;
342 547D 0 ;
343 547E 0 ;
344 547F 0 ;
345 5480 0 ;
346 5481 0 ;
347 5482 0 ;
348 5483 0 ;
349 5484 0 ;
350 5485 0 ;
351 5486 0 ;
352 5487 0 ;
353 5488 0 ;
354 5489 0 ;
355 548A 0 ;
356 548B 0 ;
357 548C 0 ;
358 548D 0 ;
359 548E 0 ;
360 548F 0 ;
361 5490 0 ;
362 5491 0 ;
363 5492 0 ;
364 5493 0 ;
365 5494 0 ;
366 5495 0 ;
367 5496 0 ;
368 5497 0 ;
369 5498 0 ;
370 5499 0 ;
371 549A 0 ;
372 549B 0 ;
373 549C 0 ;
374 549D 0 ;
375 549E 0 ;
376 549F 0 ;
377 54A0 0 ;
378 54A1 0 ;
379 54A2 0 ;
380 54A3 0 ;
381 54A4 0 ;
382 54A5 0 ;
383 54A6 0 ;
384 54A7 0 ;
385 54A8 0 ;
386 54A9 0 ;
387 54AA 0 ;
388 54AB 0 ;
389 54AC 0 ;
390 54AD 0 ;
391 54AE 0 ;
392 54AF 0 ;
393 54B0 0 ;
394 54B1 0 ;
395 54B2 0 ;
396 54B3 0 ;
397 54B4 0 ;
398 54B5 0 ;
399 54B6 0 ;
400 54B7 0 ;
401 54B8 0 ;
402 54B9 0 ;
403 54BA 0 ;
404 54BB 0 ;
405 54BC 0 ;
406 54BD 0 ;
407 54BE 0 ;
408 54BF 0 ;
409 54C0 0 ;
410 54C1 0 ;
411 54C2 0 ;
412 54C3 0 ;
413 54C4 0 ;
414 54C5 0 ;
415 54C6 0 ;
416 54C7 0 ;
417 54C8 0 ;
418 54C9 0 ;
419 54CA 0 ;
420 54CB 0 ;
421 54CC 0 ;
422 54CD 0 ;
423 54CE 0 ;
424 54CF 0 ;
425 54D0 0 ;
426 54D1 0 ;
427 54D2 0 ;
428 54D3 0 ;
429 54D4 0 ;
430 54D5 0 ;
431 54D6 0 ;
432 54D7 0 ;
433 54D8 0 ;
434 54D9 0 ;
435 54DA 0 ;
436 54DB 0 ;
437 54DC 0 ;
438 54DD 0 ;
439 54DE 0 ;
440 54DF 0 ;
441 54E0 0 ;
442 54E1 0 ;
443 54E2 0 ;
444 54E3 0 ;
445 54E4 0 ;
446 54E5 0 ;
447 54E6 0 ;
448 54E7 0 ;
449 54E8 0 ;
450 54E9 0 ;
451 54EA 0 ;
452 54EB 0 ;
453 54EC 0 ;
454 54ED 0 ;
455 54EE 0 ;
456 54EF 0 ;
457 54F0 0 ;
458 54F1 0 ;
459 54F2 0 ;
460 54F3 0 ;
461 54F4 0 ;
462 54F5 0 ;
463 54F6 0 ;
464 54F7 0 ;
465 54F8 0 ;
466 54F9 0 ;
467 54FA 0 ;
468 54FB 0 ;
469 54FC 0 ;
470 54FD 0 ;
471 54FE 0 ;
472 54FF 0 ;
473 5400 0 ;
474 5401 0 ;
475 5402 0 ;
476 5403 0 ;
477 5404 0 ;
478 5405 0 ;
479 5406 0 ;
480 5407 0 ;
481 5408 0 ;
482 5409 0 ;
483 540A 0 ;
484 540B 0 ;
485 540C 0 ;
486 540D 0 ;
487 540E 0 ;
488 540F 0 ;
489 5410 0 ;
490 5411 0 ;
491 5412 0 ;
492 5413 0 ;
493 5414 0 ;
494 5415 0 ;
495 5416 0 ;
496 5417 0 ;
497 5418 0 ;
498 5419 0 ;
499 541A 0 ;
500 541B 0 ;
501 541C 0 ;
502 541D 0 ;
503 541E 0 ;
504 541F 0 ;
505 5420 0 ;
506 5421 0 ;
507 5422 0 ;
508 5423 0 ;
509 5424 0 ;
510 5425 0 ;
511 5426 0 ;
512 5427 0 ;
513 5428 0 ;
514 5429 0 ;
515 542A 0 ;
516 542B 0 ;
517 542C 0 ;
518 542D 0 ;
519 542E 0 ;
520 542F 0 ;
521 5430 0 ;
522 5431 0 ;
523 5432 0 ;
524 5433 0 ;
525 5434 0 ;
526 5435 0 ;
527 5436 0 ;
528 5437 0 ;
529 5438 0 ;
530 5439 0 ;
531 543A 0 ;
532 543B 0 ;
533 543C 0 ;
534 543D 0 ;
535 543E 0 ;
536 543F 0 ;
537 5440 0 ;
538 5441 0 ;
539 5442 0 ;
540 5443 0 ;
541 5444 0 ;
542 5445 0 ;
543 5446 0 ;
544 5447 0 ;
545 5448 0 ;
546 5449 0 ;
547 544A 0 ;
548 544B 0 ;
549 544C 0 ;
550 544D 0 ;
551 544E 0 ;
552 544F 0 ;
553 5450 0 ;
554 5451 0 ;
555 5452 0 ;
556 5453 0 ;
557 5454 0 ;
558 5455 0 ;
559 5456 0 ;
560 5457 0 ;
561 5458 0 ;
562 5459 0 ;
563 545A 0 ;
564 545B 0 ;
565 545C 0 ;
566 545D 0 ;
567 545E 0 ;
568 545F 0 ;
569 5460 0 ;
570 5461 0 ;
571 5462 0 ;
572 5463 0 ;
573 5464 0 ;
574 5465 0 ;
575 5466 0 ;
576 5467 0 ;
577 5468 0 ;
578 5469 0 ;
579 546A 0 ;
580 546B 0 ;
581 546C 0 ;
582 546D 0 ;
583 546E 0 ;
584 546F 0 ;
585 5470 0 ;
586 5471 0 ;
587 5472 0 ;
588 5473 0 ;
589 5474 0 ;
590 5475 0 ;
591 5476 0 ;
592 5477 0 ;
593 5478 0 ;
594 5479 0 ;
595 547A 0 ;
596 547B 0 ;
597 547C 0 ;
598 547D 0 ;
599 547E 0 ;
600 547F 0 ;
601 5480 0 ;
602 5481 0 ;
603 5482 0 ;
604 5483 0 ;
605 5484 0 ;
606 5485 0 ;
607 5486 0 ;
608 5487 0 ;
609 5488 0 ;
610 5489 0 ;
611 548A 0 ;
612 548B 0 ;
613 548C 0 ;
614 548D 0 ;
615 548E 0 ;
616 548F 0 ;
617 5490 0 ;
618 5491 0 ;
619 5492 0 ;
620 5493 0 ;
621 5494 0 ;
622 5495 0 ;
623 5496 0 ;
624 5497 0 ;
625 5498 0 ;
626 5499 0 ;
627 549A 0 ;
628 549B 0 ;
629 549C 0 ;
630 549D 0 ;
631 549E 0 ;
632 549F 0 ;
633 54A0 0 ;
634 54A1 0 ;
635 54A2 0 ;
636 54A3 0 ;
637 54A4 0 ;
638 54A5 0 ;
639 54A6 0 ;
640 54A7 0 ;
641 54A8 0 ;
642 54A9 0 ;
643 54AA 0 ;
644 54AB 0 ;
645 54AC 0 ;
646 54AD 0 ;
647 54AE 0 ;
648 54AF 0 ;
649 54B0 0 ;
650 54B1 0 ;
651 54B2 0 ;
652 54B3 0 ;
653 54B4 0 ;
654 54B5 0 ;
655 54B6 0 ;
656 54B7 0 ;
657 54B8 0 ;
658 54B9 0 ;
659 54BA 0 ;
660 54BB 0 ;
661 54BC 0 ;
662 54BD 0 ;
663 54BE 0 ;
664 54BF 0 ;
665 54C0 0 ;
666 54C1 0 ;
667 54C2 0 ;
668 54C3 0 ;
669 54C4 0 ;
670 54C5 0 ;
671 54C6 0 ;
672 54C7 0 ;
673 54C8 0 ;
674 54C9 0 ;
675 54CA 0 ;
676 54CB 0 ;
677 54CC 0 ;
678 54CD 0 ;
679 54CE 0 ;
680 54CF 0 ;
681 54D0 0 ;
682 54D1 0 ;
683 54D2 0 ;
684 54D3 0 ;
685 54D4 0 ;
686 54D5 0 ;
687 54D6 0 ;
688 54D7 0 ;
689 54D8 0 ;
690 54D9 0 ;
691 54DA 0 ;
692 54DB 0 ;
693 54DC 0 ;
694 54DD 0 ;
695 54DE 0 ;
696 54DF 0 ;
697 54E0 0 ;
698 54E1 0 ;
699 54E2 0 ;
700 54E3 0 ;
701 54E4 0 ;
702 54E5 0 ;
703 54E6 0 ;
704 54E7 0 ;
705 54E8 0 ;
706 54E9 0 ;
707 54EA 0 ;
708 54EB 0 ;
709 54EC 0 ;
710 54ED 0 ;
711 54EE 0 ;
712 54EF 0 ;
713 54F0 0 ;
714 54F1 0 ;
715 54F2 0 ;
716 54F3 0 ;
717 54F4 0 ;
718 54F5 0 ;
719 54F6 0 ;
720 54F7 0 ;
721 54F8 0 ;
722 54F9 0 ;
723 54FA 0 ;
724 54FB 0 ;
725 54FC 0 ;
726 54FD 0 ;
727 54FE 0 ;
728 54FF 0 ;
729 5400 0 ;
730 5401 0 ;
731 5402 0 ;
732 5403 0 ;
733 5404 0 ;
734 5405 0 ;
735 5406 0 ;
736 5407 0 ;
737 5408 0 ;
738 5409 0 ;
739 540A 0 ;
740 540B 0 ;
741 540C 0 ;
742 540D 0 ;
743 540E 0 ;
744 540F 0 ;
745 5410 0 ;
746 5411 0 ;
747 5412 0 ;
748 5413 0 ;
749 5414 0 ;
750 5415 0 ;
751 5416 0 ;
752 5417 0 ;
753 5418 0 ;
754 5419 0 ;
755 541A 0 ;
756 541B 0 ;
757 541C 0 ;
758 541D 0 ;
759 541E 0 ;
760 541F 0 ;
761 5420 0 ;
762 5421 0 ;
763 5422 0 ;
764 5423 0 ;
765 5424 0 ;
766 5425 0 ;
767 5426 0 ;
768 5427 0 ;
769 5428 0 ;
770 5429 0 ;
771 542A 0 ;
772 542B 0 ;
773 542C 0 ;
774 542D 0 ;
775 542E 0 ;
776 542F 0 ;
777 5430 0 ;
778 5431 0 ;
779 5432 0 ;
780 5433 0 ;
781 5434 0 ;
782 5435 0 ;
783 5436 0 ;
784 5437 0 ;
785 5438 0 ;
786 5439 0 ;
787 543A 0 ;
788 543B 0 ;
789 543C 0 ;
790 543D 0 ;
791 543E 0 ;
792 543F 0 ;
793 5440 0 ;
794 5441 0 ;
795 5442 0 ;
796 5443 0 ;
797 5444 0 ;
798 5445 0 ;
799 5446 0 ;
800 5447 0 ;
801 5448 0 ;
802 5449 0 ;
803 544A 0 ;
804 544B 0 ;
805 544C 0 ;
806 544D 0 ;
807 544E 0 ;
808 544F 0 ;
809 5450 0 ;
810 5451 0 ;
811 5452 0 ;
812 5453 0 ;
813 5454 0 ;
814 5455 0 ;
815 5456 0 ;
816 5457 0 ;
817 5458 0 ;
818 5459 0 ;
819 545A 0 ;
820 545B 0 ;
821 545C 0 ;
822 545D 0 ;
823 545E 0 ;
824 545F 0 ;
825 5460 0 ;
826 5461 0 ;
827 5462 0 ;
828 5463 0 ;
829 5464 0 ;
830 5465 0 ;
831 5466 0 ;
832 5467 0 ;
833 5468 0 ;
834 5469 0 ;
835 546A 0 ;
836 546B 0 ;
837 546C 0 ;
838 546D 0 ;
839 546E 0 ;
840 546F 0 ;
841 5470 0 ;
842 5471 0 ;
843 5472 0 ;
844 5473 0 ;
845 5474 0 ;
846 5475 0 ;
847 5476 0 ;
848 5477 0 ;
849 5478 0 ;
850 5479 0 ;
851 547A 0 ;
852 547B 0 ;
853 547C 0 ;
854 547D 0 ;
855 547E 0 ;
856 547F 0 ;
857 5480 0 ;
858 5481 0 ;
859 5482 0 ;
860 5483 0 ;
861 5484 0 ;
862 5485 0 ;
863 5486 0 ;
864 5487 0 ;
865 5488 0 ;
866 5489 0 ;
867 548A 0 ;
868 548B 0 ;
869 548C 0 ;
870 548D 0 ;
871 548E 0 ;
872 548F 0 ;
873 5490 0 ;
874 5491 0 ;
875 5492 0 ;
876 5493 0 ;
877 5494 0 ;
878 5495 0 ;
879 5496 0 ;
880 5497 0 ;
881 5498 0 ;
882 5499 0 ;
883 549A 0 ;
884 549B 0 ;
885 549C 0 ;
886 549D 0 ;
887 549E 0 ;
888 549F 0 ;
889 54A0 0 ;
890 54A1 0 ;
891 54A2 0 ;
892 54A3 0 ;
893 54A4 0 ;
894 54A5 0 ;
895 54A6 0 ;
896 54A7 0 ;
897 54A8 0 ;
898 54A9 0 ;
899 54AA 0 ;
900 54AB 0 ;
901 54AC 0 ;
902 54AD 0 ;
903 54AE 0 ;
904 54AF 0 ;
905 54B0 0 ;
906 54B1 0 ;
907 54B2 0 ;
908 54B3 0 ;
909 54B4 0 ;
910 54B5 0 ;
911 54B6 0 ;
912 54B7 0 ;
913 54B8 0 ;
914 54B9 0 ;
915 54BA 0 ;
916 54BB 0 ;
917 54BC 0 ;
918 54BD 0 ;
919 54BE 0 ;
920 54BF 0 ;
921 54C0 0 ;
922 54C1 0 ;
923 54C2 0 ;
924 54C3 0 ;
925 54C4 0 ;
926 54C5 0 ;
927 54C6 0 ;
928 54C7 0 ;
929 54C8 0 ;
930 54C9 0 ;
931 54CA 0 ;
932 54CB 0 ;
933 54CC 0 ;
934 54CD 0 ;
935 54CE 0 ;
936 54CF 0 ;
937 54D0 0 ;
938 54D1 0 ;
939 54D2 0 ;
940 54D3 0 ;
941 54D4 0 ;
942 54D5 0 ;
943 54D6 0 ;
944 54D7 0 ;
945 54D8 0 ;
946 54D9 0 ;
947 54DA 0 ;
948 54DB 0 ;
949 54DC 0 ;
950 54DD 0 ;
951 54DE 0 ;
952 54DF 0 ;
953 54E0 0 ;
954 54E1 0 ;
955 54E2 0 ;
956 54E3 0 ;
957 54E4 0 ;
958 54E5 0 ;
959 54E6 0 ;
960 54E7 0 ;
961 54E8 0 ;
962 54E9 0 ;
963 54EA 0 ;
964 54EB 0 ;
965 54EC 0 ;
966 54ED 0 ;
967 54EE 0 ;
968 54EF 0 ;
969 54F0 0 ;
970 54F1 0 ;
971 54F2 0 ;
972 54F3 0 ;
973 54F4 0 ;
974 54F5 0 ;
975 54F6 0 ;
976 54F7 0 ;
977 54F8 0 ;
978 54F9 0 ;
979 54FA 0 ;
980 54FB 0 ;
981 54FC 0 ;
982 54FD 0 ;
983 54FE 0 ;
984 54FF 0 ;
985 5400 0 ;
986 5401 0 ;
987 5402 0 ;
988 5403 0 ;
989 5404 0 ;
990 5405 0 ;
991 5406 0 ;
992 5407 0 ;
993 5408 0 ;
994 5409 0 ;
995 540A 0 ;
996 540B 0 ;
997 540C 0 ;
998 540D 0 ;
999 540E 0 ;
1000 540F 0 ;

```

## SOFTWARE GAMES

```

192 551A FE44 J CPJ V0MR ;1X16 BYTE OF VOM MEM.
193 551C DR RNC ;
194 551D C04854 AD LK ;K-NOBARS
195 551F 67 MOV M,A ;
196 5520 C9 RET
197 5521 0 ;
198 5522 0 ;
199 5523 0 ;
200 5524 0 ;
201 5525 0 ;
202 5526 0 ;
203 5527 0 ;
204 5528 0 ;
205 5529 0 ;
206 552A 0 ;
207 552B 0 ;
208 552C 0 ;
209 552D 0 ;
210 552E 0 ;
211 552F 0 ;
212 5530 0 ;
213 5531 0 ;
214 5532 0 ;
215 5533 0 ;
216 5534 0 ;
217 5535 0 ;
218 5536 0 ;
219 5537 0 ;
220 5538 0 ;
221 5539 0 ;
222 553A 0 ;
223 553B 0 ;
224 553C 0 ;
225 553D 0 ;
226 553E 0 ;
227 553F 0 ;
228 5540 0 ;
229 5541 0 ;
230 5542 0 ;
231 5543 0 ;
232 5544 0 ;
233 5545 0 ;
234 5546 0 ;
235 5547 0 ;
236 5548 0 ;
237 5549 0 ;
238 554A 0 ;
239 554B 0 ;
240 554C 0 ;
241 554D 0 ;
242 554E 0 ;
243 554F 0 ;
244 5550 
```

# Letters to the Editor

Dear Editor:

As a recent subscriber I find your magazine very enjoyable. The sections listing new equipment are very helpful. While reading the March issue I came to a grinding halt on page 102 - The Qube - and felt obliged to write.

The Qube idea has been kicked around by some friends and myself on several occasions and we have come up with a few objections.

The absorption of a photon of appropriate energy to produce a change in atomic or molecular structure occurs at the atomic or molecular level. This absorption causes a change in the rotational or vibrational energy or electronic orbital structure of the atom or molecule involved and is independent of "candle power." In other words, the threshold for a transition depends on frequency, and therefore energy, not intensity. I am not aware of any materials that would behave the way Mr. Garrett wishes, but you never know what will turn up.

An analogy may be drawn using photographic emulsions. One could arrange the intensities of two lasers such that the emulsion at their intersection would (after processing) be black, but one would then have a gray at all points through which a single beam had passed. The same, I fear, would occur in Mr. Garrett's Qube. Diffraction would be a major problem for the same reason.

There is a ray of hope. Recent advances in epitaxial growth methods point to a possibility of producing a finished product that has much the same potential as the proposed Qube.

One last note, there is no way to intersect two cylindrical beams and get a sphere.

Charles Springer  
Gig Harbor, WA 98335

*Why, so far, no responses from  
Silicon Valley?*

-editor

Dear Editor:

I was totally enthralled by Edward Christianson's article on stock options in the February issue. His hard labors, and effective software were quite evident, and deserving of my vote as the best article of the month.

However, being a computer amateur, and a financial professional (I think), I must question the tone, and content of his article.

The author approaches the stock market (options) definitely as a "bull." A novice cannot but notice this in the body of his description, and the analytical examples he states. The market goes down, as well as it goes up, and over the short term which option trading favors, I fear the odds at loss are greater than gain.

Particularly troublesome to me was his use of proceeds, and his definition of break-even. To meet the criteria he describes, the market would have to be in an "uptick" (more up sales than down) on average for the length of the option in order to realize a profit from the sale. If not, the option buyer would be unlikely to exercise the option. Therefore, the proceeds as used by the author are no longer based on the strike price (price on execution of the option) but now have evaporated to the market level. You as the seller are now stuck with the stock and locked in for the length of the option unless you sell another option, or sell the stock and become uncovered. However, your strategy has now become defensive probably in a sliding market. The break-even point is now greater since the proceeds are now at market value, and the profit if any reduced accordingly.

Perhaps the author's conditioning was based on reinvestment and compounding of the collected option immediately on receipt; if so, this did not come across in the arithmetic for the items I listed. However, if this was indeed his intention, one must point out that the risk is also compounded from high to potentially catastrophic. I'd hate to have my micro (et al) repossessed.

Dick Carideo  
Malden, MA

Dear Editor:

I have some interest in stock options so the first article I read in February's issue was the one on "Microcomputer Stock Options".

I noticed that Examples 1 through 3 in the article showed that situations which offered greater oppor-

tunity for gain also had less risk as shown by higher return and lower break-even values. This is rarely, if ever, the case in the market. The problem is with the way the break-even value is computed. Edward Christianson does this by subtracting return from total cost. However, this return is based on the premise that the stock underlying the option will rise to or remain at or above the strike price of the option. If the stock fails to rise or worse yet, drops in value, the return is diminished or disappears altogether at the break-even point.

Break-even should be defined as total cost minus total receipts (from dividends and option premiums). The program can be fixed by replacing statement number 1520 as follows:  
$$1520 R3 = (INT((C5-T2-T3) * 100 / S1) / 100).$$

James M. Pierce  
Clarksville, Md.

Dear Editor:

It is always a temptation to try to get something for nothing. In your Vol. 2 Issue 3, February 1977, issue of INTERFACE AGE, there is an article on page 45 on building a 12 bit tracking Analog-Digital Converter. This type of ADC uses an internal 12 bit DAC which in this case is put together from two 6-bit DACs. This does not give 12 bit accuracy. This can be seen by considering the accuracy limitations on the more significant DAC. Normally it provides an output which should be accurate to at least  $\pm 1/2$  LSB. However, when working with the additional DAC, its output LSB will be divided into  $2^6$  (=64) steps by this less significant DAC. Thus, to deliver 12 bit accuracy the LSB of the more significant DAC must actually be accurate to better than  $1/2 \times 1/64$  of a step (which far exceeds the accuracy specifications of commercial products). Precision Monolithics, Inc., specifies their 6 bit DAC-01 as having 7 bits of accuracy. Thus, if two of them are put together, about 7 bits of accuracy can be expected, not 12 or 14 bits.

One would probably save money and gain in accuracy by using one 10 bit DAC to start with. If 12 bit accuracy is really needed (real 10 bit accuracy is usually sufficient), then a 12 bit DAC should be used.

Henry E. Schaffer  
Professor of Genetics  
North Carolina State University  
Raleigh, N.C.

## 6800 CROSS ASSEMBLER

Standard Motorola format. Written in FORTRAN IV for CDC CYBER 74, but will run on any machine with 36 bit or larger word with slight changes. (Modification instructions included.)

Punched cards (26 punch) &

Listing \$55.00 ppd.  
Listing only \$37.50 ppd.

APPLIED MICROCOMPUTER SYSTEMS  
386 Puffton Village, Amherst, Mass. 01002

## BUSINESS SOFTWARE FOR YOUR ALTAIR

Management Problem Solving Package (MPS)

- On ALTAIR format diskette
- Complete Documentation and User Manual
- Two Year Update Service
- \$150 (Introductory price good till 6/30/77)

BUSINESS COMPUTER SYSTEMS

216 Collier Dr., Springfield, IL 62704

## ADD COLOR TO EXISTING TV GAMES WITH A "CHROMA-PLEX 7700" DIGITAL CHROMA MULTIPLEXER KIT!

EASILY ADAPTED TO MOST BLACK AND WHITE GAMES. (i.e., General Instrument License One Day 2400's, CHD, MDS, P.T. Oscillator, Low Power Requirements: 1.0V mp, 0.5mA, 0.5" x 4" double-sided hole board. DOZENS OF COLOR COMBINATIONS POSSIBLE. VERY VERSATILE. EASILY ASSEMBLED IN ONE EVENING. \$30.00 P.P. ORDER BY PHONE OR MAIL. DIAL 482 397-3771.

ATV Research, Inc. 131 BROADWAY SAKOTA CITY, NE. 68211

## PROTECT YOUR INVESTMENT

Cover your  
Altair/Imael/SWT PC Computer

Is your computer chassis open and collecting dust while you plug boards in and out trying new hardware configurations?

Our heavy vinyl cover will keep harmful dust and dirt out of your chassis and protect it from scratches and bangs. Specify make with order.

\$6.25 plus .75 postage and handling

## JOYSTICK KIT

Control: Games; Interactive Graphics; Cursor Positioning; Process Control  
No expensive Analog Interface required. Connects directly to one (1) output line and two (2) input lines.

Joystick Kit (Model QB690)

\$49.95 plus \$1.00 postage

Send check or money order to:

QUBED<sup>3</sup>

P.O. Box 7104

West Trenton, N.J. 08628

## THE COMPUTER CORNER

"Brains are our Business"

- ✓ IMSAI 8080, POLY-88, Processor Tech
- ✓ Books, Magazines TVT Supplies, Brain Games

Hours: 10-6 pm daily & Sat.: Thurs. 10-9 pm

White Plains Mall, 200 Hamilton Ave.

WHITE PLAINS, NY 10601

Telephone: (914) 948-2474

## AMCO HAS APPLE!

APPLE COMPUTERS

AMCO ELECTRONIC SUPPLY

635 E. ARROW HIGHWAY

AZUSA, CA 91702

Phone: (213) 332-2216

## ELIMINATE INTERFERENCE

Keep Power Line noise & transients out of your system. Bonus! No more TV, Stereo or Radio interference. Wires directly into computer, teletype, power supply. Postpaid.

ELF-3 \$9.50 — 3 amp Line Filter  
ELF-10 \$12.50 — 10 amp Line Filter

Filter/Transient ELF-3 (3 amp) \$14.25  
Suppressor ELF-10 (10 amp) \$17.25

ELECTRONIC SPECIALISTS, INC.

171 St. Main, Natick, Mass 01780

## EXPERTISE Agency

MINICOMPUTERS, MICROPROCESSORS, CALCULATORS and software bought, sold and traded. We are a modern technology brokerage bringing buyers and sellers together. Contact us to be listed.

P.O. Box 632T Santa Ana, CA 92702

## ORDERS BACKLOGGED? WE CAN HELP YOU FAST

PC board and small mechanical assembly are our specialty. Lead bending, wave soldering and conscientious competent attention to detail are our resources. We also know how to control costs. Our prices will surround you. Call or write to me:

Marlin J. Ebert, General Manager

Electro Manufacturing Corporation

2582 First Street

Livermore, California 94550

(415) 447-4848

## METRO TORONTO

IMSAI dealer—friendly advice—best prices

Microcomputer Systems of Canada

4 Benomara Crescent

Scarborough, Ontario

M1H 1K7

(416) 497-9444/438-5583

## 33 TTY's FOR SALE OR RENT

EXCLUSIVE VARDON SYSTEMS  
REDUCES ORAL AND NOISE  
50% OR MORE

ASR 400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

400 1138 45

GET COMPLETE DETAILS WITH A DIRECT CALL:

(214) 253-7502 • TWX 910-880-5781 • TELEFAX 73-0032

Vardon & Associates, Inc.

300 N. Beltline Road • Irving, Texas 75061

A Subsidiary of Vardon, Texas Corporation

AVAILABLE—for the first time at a low, low price.

82521—64-Bit

Bipolar High Speed

write while-read Ram

(25 NS-Type) Ram

\$150

25 or more \$1.00 each

(Data Sheets Included)

High Output Swing—20V

High Output Current—

1.5 amp

High Res Rate—50 MHz

Packaging—MiniDip!

Power Supply Transformers—your choice \$5 each

Pr: 115V A.C. Pr: 115V A.C.

Sec: 28V C.T. @ 2 amps Sec: 16V C.T. @ 5 amps

14V C.T. @ 3 amps 55V @ 1/2 amp, 3 lbs

2 lbs.

C.D. Model Number NF20884

3 amp 110 or 220 V.A.C. in line P.F. Filter, standard 3 prong

male power in connector and 3 prong accessory outlet,

4 x 4 1/2 x 2 (with mounting feet)

\$5.00 each ————— shipping weight 1 1/2 lbs.

Voltage Sensitive Relay Modules

P.C. Board Construction in Clear Plastic. Plug-in module. 11 pin

plug (same style as Octal But 11 pin) operates on 110 or

220. Voltage sense adj. from approx. 4.5-6.0 volts D.C.

2 POT 5 amp Power Relay. Good for 5 volt over voltage

protection, etc.

\$3.50 each (schematics & Hookup included)

A.C. Surplus Electronics

1180 "C" Fountain Way

Ann Arbor, MI 48106

(714) 620-5251

TERMS: Send check or money order (on C.D.D.'s) Minimum

order \$10.00. Include \$1.00 for handling. On orders over \$20.00

add 5% for postage and handling. 8% Foreign. Cash, residents

add 6% sales tax. Include additional sufficient postage for items

with shipping weight listed.

NOTE: Items limited to stock on hand & subject to prior sale. All items listed are preflight and guaranteed.

# MICRO-MARKET

## VIDEO CHECKERS

As described in March issue but now complete. Plays under MITS 8K Basic (B.J.). Total of 16K memory and poly video bd. required. Send \$10 postpaid for Tarbell format cassette and complete documentation.

## COMPU-QUOTE

6914 Berquist Ave., Canoga Park, CA 91307

## LONG ISLAND

IMSAI Dealer

COMPUTER MICROSYSTEMS

Kits • Parts • Service • Books • Magazines

1309 Northern Blvd., Manhasset, N.Y. 11030

Telephone (516) 827-3840



A.D.M.

Communications, Inc.

Teletype & Communications

Equipment

Buy—Sell—Recondition

1322 Industrial Ave.

Escondido, CA 92025

(714) 747-0374 Telex: 695097

## End your video display problems

quickly with a "PIXE-VERTER"

Manufacturer's matched coding, with custom circuitry, a TV receiver, into a mp video video monitor. Connects directly to antenna terminals. In many instances required to be the TV receiver or channels. P.C. Power requirements: 5-6 volts, 3 ma. (No need for complex electronic TV circuitry video receiver etc. Dist: 1.25" x 1.25". Kit model—PXA-24 \$8.95. Order by phone or mail.

DIAL 482 397-3771

ATV Research, Inc. 131 BROADWAY SAKOTA CITY, NE. 68211

## Computer Mart of New York Inc.

314 Fifth Ave., New York, N.Y. 10001

Microcomputers, Books, Components, Parts

Authorized Dealer—Service—Friendly Advice

Closed Monday

Open 10-6 Tues.-Sat. STAN VEIT,

10-9 pm on Thurs. Storekeeper

Telephone (212) 279-1048

## 21 SHEOSTRING START-AT-HOME

COMPUTER BUSINESSES

113 page research report uncovers areas never published. \$12.00 (Check, Mastercard, BankAmericard)

Guaranteed Refundable

DATASEARCH

730 Wadsworth, Suite 108-F

Deerfield, IL 60015

## SOUTH FLORIDA

Sunny Computer Stores, Inc.

Authorized Dealer:

IMSAI, Southwest, Commodore, CIO, Vector and others

Books, Magazines, Newspapers, Service and Supplies

University Shopping Center

12384 South Dixie Highway

Coral Gables, Fla. 33148

(305) 881-6042

## COMPUTER HOBBYISTS!

Nationwide Classified

Advertising Newsletter

Buy & Sell Hardware & Software

new/used/unique/low cost

\$3.75 for 18 issues.

Free sample issue on request.

ON LINE Newsletter

24895 Santa Cruz Hwy, Los Gatos, Ca. 95030

# FIFO FLEA MARKET

**FOR SALE:** F-8 Kit \$150. Never used; full documentation 4CX250B UHF tubes \$15 ea. HW-32 20M transceiver w/DC converter. Mint cond. \$125. Electrovoice 911B mike w/stand \$15. D.R. Morse, 8843 De Havilland Ave., Los Angeles, CA 90045. (213) 641-1702 P.M., (213) 648-0577 A.M.

**FOR SALE:** Complete Viatron System 21 with communications adaptor (missing UART); Includes all data and about six Viatapes, \$375.00. Printing robot and Interface to Viatron, \$175.00. IBM Selectric Model 72 typewriter, \$300.00 Will take \$730.00 for all or make offer. All in perfect operating condition; you ship. Write or call (after 6 P.M.) Keith Teague WB5FMJ, P.O. Box 65, Alma, ARK 72921, (501) 632-2532.

**FOR SALE:** SwTpc II w/computer cursor control and RS232 interface - plus - case (aluminum). ALL. For \$250.00. ALSO MITS 88-acc board (assembled and tested) For \$95.00. AND MITS 8K BASIC (on cassette) 4.0 version For \$50.00. WRITE: E. V. Lipps, 205 Chautauqua, Pacific Palisades, CA 90272. (213) 454-7690 (after 4:00).

**FOR SALE:** Centronics 102A Printer, 9 x 7 dot matrix printer, 330 CPS, \$1800. Also a Centronics 101A Printer, 9 x 7 matrix, 165 CPS, \$1600.00. R. D'Ambrosi, 817 S. Second St., Ronkonkoma, N.Y. 11779. (516) 585-0697.

**SELL:** Hewlett Packard type 160B oscilloscope. DC to 14 MHz. Triggered sweep in 24 ranges, with dual trace vertical plug-in and delayed sweep/mixed sweep horizontal plug-in. Working in good condition, \$275. Jim Stilwell, 6614 N. 82nd Pl., Scottsdale, AZ 85253. (602) 948-8214.

**FOR SALE:** Phi-Deck 5 new units. \$100 ea. \$25 with order. Balance C.O.D. Ron Riley, Box 4310, Flint, MI 48504.

**FOR SALE:** Digideck Model 60 cassette drive for sale. Complete with case, power supply, interface circuitry and manual. Connects to two 8 bit I/O ports for full software control. Set up for recording data on one channel and clock on the other, but channels can be used independently. \$200. Also 100 pin wire wrap circuit board connectors (.125" centers) \$4.25 ppd. Peter Smart, 386 Puffin Vig., Amherst, Mass. 01002.

**FOR SALE:** TTY/Paper Tape. 1 inch wide, 8 inch diameter rolls, buff, oiled. Perfect for ASR-33. \$5.00 + UPS shipping per 7 roll carton (12 lbs.) or \$15.00 per 28 roll case + UPS. Two or more cases, \$12.50 each + UPS. Dan S. Parker, 1007 3rd St. #3, Davis, CA 95616. (916) 758-2341 evenings.

**FOR SALE:** One MITS 4K static memory board and one MITS 4K dynamic memory board, \$165 each. One Proc Tech 8K memory board \$315. All boards fully socketed, fully assembled and work perfectly. J. R. Fish, 2121 Columbia Pike #208, Arlington, VA 22204. (703) 521-6763.

**USER'S GROUP:** for 2650-based microprocessor as featured in April '77 Radio-Electronics. Contact G. Frank Humiston, 506 Wayne Ave., El Cajon, CA 92021.

**WANTED:** Computer oriented commodity trend analysts for exchange of views. Marvin Friedman, P.O. Box 29, Brooklyn, N.Y. 11230.

**FOR SALE:** Assembled and tested Poly-88 complete w/full backplane and 64 computer video interface plus 4.0 monitor. Price \$775. Contact: Marvin Mallon, (213) 348-3662 evenings.

**MICRO-MARKET AD RATE:** \$25.00 per column inch. Max. 4 column inches per ad. Submit ads to Micro-Market Ads—INTERFACE Magazine, P.O. Box 1234, Cerritos, CA 90701.

**PERSONAL:** Are you a friend of absent-minded Mike Golden? Tell him his 16K memory is waiting for him at the Computer Store in Santa Monica!

**FOR SALE:** One Central Data 2650 Board with 8K of static RAM, power supply, and cabinet. Has connectors for the keyboard, video monitor, and tape recorder and is totally assembled and tested. Best offer over \$850.00. Also have a switch console for the 2650 Board. Has address, data, and control bus switches as well as hardware breakpoint and single step. \$250.00. J. Roloff, 2214 Brookshire Drive, Champaign, IL 61820.

**AVAILABLE:** Data Reference Card for RCA 1802 microprocessor. Send \$1.00 plus self addressed stamped envelope to: R. W. Moell, 5505 Daywood Ct., Raleigh, NC 27609.

**FOR SALE:** Why buy a mini-floppy when you can get a full size floppy disc from a major computer manufacturer. Rebuilt and warranted — like new for 120 days. \$495.00 plus freight. Send to: Geo. Gregoire, 555 Paularino-B102, Costa Mesa, CA 92626. (714) 557-0371.

## FIFO FLEA MARKET ADS

### ★ PERSONALS FREE ★

Max. 10 lines per ad. Submit Ads to: FIFO Ads—INTERFACE AGE Magazine, P.O. Box 1234, Cerritos, CA 90701.

## COMING IN FUTURE ISSUES

**BIONICS** — a series of articles on microprocessor applications in prosthetic devices for the handicapped.

**GENERAL LEDGER PACKAGE** — The first of a series of software articles for serious business applications. The author is Bud Shamburger. He is the owner-operator of a Ramada Inn and uses his ALTAIR™ 8800B system in a practical, down-to-earth manner to minimize waste and maximize profits.

**FORTAN/BASIC CONVERSIONS** — William C. Thompson III gives you an easy-to-read conversion key.

**DAY OF THE WEEK** — Jim Huffman appeals to chronologists and history buffs with this useful and entertaining program for the SWTP 6800.

# INTERFACE<sup>TM</sup>

AGE

## MICROCOMPUTING FOR HOME AND THE SMALL BUSINESSMAN

The professional publication bringing microcomputing technology to the hobbyist, small businessman, educator, engineer and student. Every issue edited to bring technology and people together in the simplest manner.



**INTERFACE AGE** is packed with

- **HARDWARE ARTICLES** — Product profiles, comparisons, applications, modifications and construction projects.
- **SOFTWARE ARTICLES** — Microcomputer development software, short software routines, application software, off-line software storage formats, software communication standards and access to the microcomputer software depository for all **INTERFACE AGE** readers.
- **TUTORIALS** — Fundamentals of micro processors, basics for microcomputing, professional to technical transition information, understanding software, elementary math for computing.
- **NEW PRODUCTS** — Manufacturer profiles and latest product releases.
- **USER COMMUNICATION** — **UPDATE** — devoted to club and organization announcements and activities. — **LETTERS TO THE EDITOR** — Reader forum for expression of opinions and feedback on articles and features.
- **MICRO-MARKET/FIFO FLEA MARKET** — Low cost/no cost advertising for the new marketer/garage sale enthusiast.



If you need to know how to get started in microcomputing or need the valuable software once your system is completed then **INTERFACE AGE** is a must for you.

### Don't Delay — Subscribe Today!

MAKE CHECK PAYABLE TO: INTERFACE AGE MAGAZINE	
P.O. Box 1234 Cerritos, CA 90701	12 Monthly Issues: \$10 U.S., \$12 Can./Mex. \$18 International
Name _____	
Address _____	
City _____ State _____ Country _____ Zip _____	
Date _____ Signature _____	
<input type="checkbox"/> CHECK	<input type="checkbox"/> MONEY ORDER
<input type="checkbox"/>  <input type="checkbox"/> 	
Account # _____	Expires _____



# ADVERTISING INDEX

Information Inquiry Number		Page	Information Inquiry Number		Page
<b>MANUFACTURERS</b>					
1	Associated Electronics	51	57	Technical Design Labs	47
2	Comtek	60	58	Ultra-Byte	8C
3	Comten Industries	42	59	Vector Graphics	67
4	CompuTime	43	60	Vandenberg Data	64
5	Continental Specialties	19	61	Xybek	53
6	Creative Microsystems	74	<b>COMPUTER STORES</b>		
7	Cromemco	1	62	Bits, Bytes & Pieces	92
8	Digital Group	3	63	Bits N Bytes, Fullerton, CA	96
9	DithiumMatrix	44	64	Byte Shop, Tempe, AZ	79
10	E & L Instruments	11	65	Byte Shop, Tempe, AZ	93
11	Electronic Control Technology	43	66	Byte Shop, Pasadena, CA	81
12	Enclosure Dynamics	45	68	Byte Shop, Westminster, CA	98
101	Expander	70	69	Byte Shop, Miami, FL	122
13	Fabritek	75	70	Byte Shop, Columbia, SC	78
14	Franklin Electronics	15	71	Computer Enterprises	96
15, 16, 17, 18 19, 20, 21, 22	Heathkit	31, 32, 33, 34	72	Computer Center	110
	IMSAI	CI11	73	Computer Components	107
	IMSAI	13	74	Computer Machine Services	106
26	Intelligence Systems	6, 7	75	Computer Mart, NY	98
	Hal Communications	73	76	Computer Playground	99
28	Microcomputer Associates	63	77	Computer Store, Santa Monica, CA	101
29	Microdesign	42	79	Computer Warehouse	105
30	Microgram	18	80	Disc 3	107
31	Micropollis	69	81	Electronic Warehouse	131
32	Microterm	61	82	General Computer Company	76
33, 34, 35, 36	Miniterm	21, 13, 25, 27	83	Metatech Corporation	92
37	MPI	59	84	People's Computer Shop	90
38	National Multiplex	19	85	Sunshine Computer Company	113
39	Objective Design	51	86	Synchro-Sound	94
40	Ohio Scientific	49	87	Tech-Mart	121
41	OK Machine & Tools	55		Ximedia	91
42	Omni Systems	53	<b>SURPLUS</b>		
43	PAIA Electronics	71	88	Advanced Microcomputer Products	115
44	Parasitic Engineering	63	89	Atwood Enterprises	122
102	Parasitic Engineering	70	90	Byte Magazine	108
45	Peripheral Visions	37	91	Computerfest	102
46	Prime Radix	5	92	Digikey	125
47	Processor Technology	65	93	Integrated Circuits Unlimited	117
48	Processor Technology	38, 39		INTERFACE AGE	83
50	Pyramid Films	62	95	Jade Company	127
51	Scientific Research	9	96	Osborn & Associates	124
53	Sharp & Associates	46	97	Quest Electronics	80
54	SWTP	IFC	98	S. D. Sales	133
55	Sylvanhill Lab	62	99	United Technical Publications	87
56	Sinetics Design	22			

## CAST YOUR VOTE

The authors of this issue would like to know your feelings as to which article you consider the best. You may cast your vote on *only* one article. Rather than voting on the usual 1 to 10 basis, select the best article and circle the corresponding number on the readership service card.

At the end of the voting period all votes will be tallied, the highest scoring article will be announced and the author will receive a \$100 bonus.

Also, since we have changed computing services, please note the address change on the reader service card to: INTERFACE AGE Magazine, Box 2654, Clinton, Iowa 52732.

## ARTICLE

389. Computrac 2000  
By Robert Cheeseboro
390. The Search for a Good, Random Access, Record Cutting Juke Box  
By William Blomgren
391. Robert Uiterwyk's 4K BASIC  
By William W. Turner
392. Help Your Computer Understand Your Voice  
By Owen F. Thomas
393. Convert Motorola 6800 Hex Format to Intel Format  
By Floyd Nordin
394. User TTY Handler for the Z-80 Development System  
By Richard E. Maly
395. Number Base Conversion Routine  
By John W. Swain
396. SC/MP Seiko Printer Interface and Program — SSEIKOPP  
By Phillip Roybal
397. Checkbook Balancer Program — JHCBBP  
By Jim Huffman
398. Logan . . . A Logic Circuit Analysis Program  
By Robert J. Bishop
399. Apple Star-Trek  
By Robert J. Bishop
400. John Conway's Game of Life  
By Alan R. Miller

# INTERFACE<sup>TM</sup>

May 1977 Issue  
 Void after August 31, 1977  
 (Please type or print)

Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Company \_\_\_\_\_ Phone (A/C) \_\_\_\_\_  
 Address \_\_\_\_\_ ☐ Home ☐ Business  
 City \_\_\_\_\_ State \_\_\_\_\_ Country \_\_\_\_\_ Zip \_\_\_\_\_

**ANSWER THE FOLLOWING BY CHECKING  
 ONE BOX ONLY PER QUESTION.**

**1. I Am A**

- ☐ A Professional (Medical, Accounting, Law, Etc.)  
☐ B Engineer (Electronics, Mechanical, Etc.)  
☐ C Business Person (Retail, Wholesale, Etc.)  
☐ D Educator (Professor, Teacher, Assistant, Etc.)  
☐ E Other

**2. I am a**

- ☐ A Hobbyist  
☐ B Other

**3. My Status is**

- ☐ A Have All Computing Equipment  
☐ B Need More Peripherals  
☐ C Have CPU Only  
☐ D Have No Equipment  
☐ E Other

**4. I Need This Information For**

- ☐ A Immediate Purchase  
☐ B Purchase 30-60 Days  
☐ C Comparison  
☐ D Literature Library  
☐ E Other

**5. My Interest Emphasis is**

- ☐ A Hardware  
☐ B Software  
☐ C Other

**6. My Application is**

- ☐ A Hobby Only  
☐ B Business Only  
☐ C Instructional Purposes  
☐ D Research  
☐ E Design & Development  
☐ F Other

**7. My Primary Source Of "State-of-the-Art"**

- ☐ A Magazines  
☐ B Exhibits & Conventions  
☐ C Club Meetings  
☐ D Direct Mail From Manufacturers  
☐ E Other

**8. I prefer To Buy**

- ☐ A Quality From Manufacturers  
☐ B Local Computer Reseller (Store)  
☐ C Mail Order  
☐ D Club Group Purchases  
☐ E Other

**9. I Look To INTERFACE AGE First For**

- ☐ A New Product Information  
☐ B Software Information  
☐ C Tutorials  
☐ D Hardware Articles  
☐ E Product Advertising  
☐ F Remarks

# INTERFACE<sup>TM</sup>

May 1977 Issue  
 Void after August 31, 1977  
 (Please type or print)

Name \_\_\_\_\_  
 Title \_\_\_\_\_  
 Company \_\_\_\_\_ Phone (A/C) \_\_\_\_\_  
 Address \_\_\_\_\_ ☐ Home ☐ Business  
 City \_\_\_\_\_ State \_\_\_\_\_ Country \_\_\_\_\_ Zip \_\_\_\_\_

**ANSWER THE FOLLOWING BY CHECKING  
 ONE BOX ONLY PER QUESTION.**

**1. I Am A**

- ☐ A Professional (Medical, Accounting, Law, Etc.)  
☐ B Engineer (Electronics, Mechanical, Etc.)  
☐ C Business Person (Retail, Wholesale, Etc.)  
☐ D Educator (Professor, Teacher, Assistant, Etc.)  
☐ E Other

**2. I am a**

- ☐ A Hobbyist  
☐ B Other

**3. My Status is**

- ☐ A Have All Computing Equipment  
☐ B Need More Peripherals  
☐ C Have CPU Only  
☐ D Have No Equipment  
☐ E Other

**4. I Need This Information For**

- ☐ A Immediate Purchase  
☐ B Purchase 30-60 Days  
☐ C Comparison  
☐ D Literature Library  
☐ E Other

**5. My Interest Emphasis is**

- ☐ A Hardware  
☐ B Software  
☐ C Other

**6. My Application is**

- ☐ A Hobby Only  
☐ B Business Only  
☐ C Instructional Purposes  
☐ D Research  
☐ E Design & Development  
☐ F Other

**7. My Primary Source Of "State-of-the-Art"**

- ☐ A Magazines  
☐ B Exhibits & Conventions  
☐ C Club Meetings  
☐ D Direct Mail From Manufacturers  
☐ E Other

**8. I prefer To Buy**

- ☐ A Quality From Manufacturers  
☐ B Local Computer Reseller (Store)  
☐ C Mail Order  
☐ D Club Group Purchases  
☐ E Other

**9. I Look To INTERFACE AGE First For**

- ☐ A New Product Information  
☐ B Software Information  
☐ C Tutorials  
☐ D Hardware Articles  
☐ E Product Advertising  
☐ F Remarks

Please send information on items circled below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25  
 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50  
 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75  
 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125  
 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150  
 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175  
 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200  
 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225  
 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250  
 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275  
 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300  
 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325  
 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350  
 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375  
 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

Please send information on items circled below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25  
 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50  
 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75  
 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100  
 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125  
 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150  
 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175  
 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200  
 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225  
 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250  
 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275  
 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300  
 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325  
 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350  
 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375  
 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400

Please use only 1 card per person. Thanks!

Please use only 1 card per person. Thanks!

SUBSCRIPTION

# READER SERVICE CARD



We've got something for every baud!

## SUBSCRIPTION APPLICATION FORM PAYMENT MUST ACCOMPANY FORM

SUBSCRIPTION FEE per year: \$10.00 U.S., \$12.00 Canada/Mexico, \$18.00 Foreign.

Make check payable to:

**INTERFACE<sup>TM</sup> Magazine**  
 P.O. Box 1234, Cerritos, CA 90701

Name \_\_\_\_\_ Title \_\_\_\_\_  
 Company \_\_\_\_\_  
 Home Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Country \_\_\_\_\_ Zip \_\_\_\_\_  
 Date \_\_\_\_\_ Signature \_\_\_\_\_

☐ CHECK

☐ MONEY ORDER

☐ **MasterCard**

☐ **Visa**

Account # \_\_\_\_\_ Expires \_\_\_\_\_

## PLANNING TO MOVE?

Let us know 8 weeks in advance so that you won't miss a single issue of *INTERFACE*.

Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly.

If you have no label handy, print OLD address here.

Please Print

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip code \_\_\_\_\_

**Attach Label**    **Print NEW address here**

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip code \_\_\_\_\_

**MAIL COMPLETED CARD TO:**

**INTERFACE<sup>TM</sup> Magazine**

P.O. Box 1234  
Cerritos, California 90701

First Class  
Permit No. 217  
Clinton, Iowa

### BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

**INTERFACE<sup>TM</sup> Magazine**

**Box 2654**

**Clinton, Iowa 52732**

First Class  
Permit No. 217  
Clinton, Iowa

### BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

Postage will be paid by

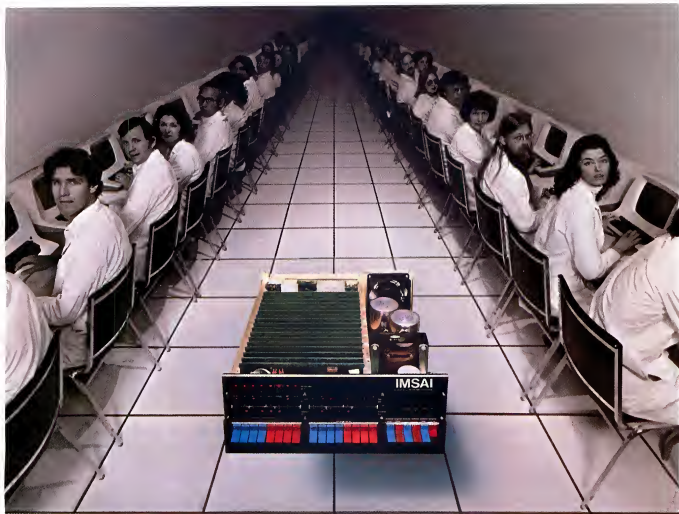
**INTERFACE<sup>TM</sup> Magazine**

**Box 2654**

**Clinton, Iowa 52732**



# POWER.



## IMSAI Introduces the Megabyte Micro.™

### The Megabyte Memory

Until today, the largest memory you could fit and address in a single microcomputer CPU was 65K.

Now, IMSAI presents an incredible memory system for micros 16 times more powerful than yesterday's best.

Imagine, a full megabyte of power from sixteen 65K RAM boards.

And, to control all this, the IMSAI Intelligent Memory Manager (IMM), the super control board.

You can write protect blocks throughout the full megabyte. Or, map in 16K blocks.

Plus, preset 16 mapping configurations with protect for high speed transfer or rapid change.

All interrupts are fully vectored, and there's an interrupt if an attempt is made to write into protected memory.

There's even a real "time of day" clock.

### 65K, 32K and 16K RAM Boards

Until today, the most memory you could plug into a single slot was 16K.

Now, IMSAI presents memory boards in astonishing multiples of sixteen: 65K, 32K and 16K low power, dynamic RAM Boards. They can be used in any S-100 bus computer individually or in combination to form conventional systems up to 65K bytes.

Every board is fast. With "hidden refresh" and no "wait state."

### The Complete Megabyte Microcomputer System

The IMSAI Megabyte Micro™ is only part of the story. The full system can include dual floppy disks, terminals, plotters, printers and tape cassettes.

IMSAI also offers the finest high level and peripheral software available. Paper tape and Tape Cassette I/O and super Disk Operating Systems. Plus, BASIC and Disk BASIC with more high level languages coming.

Until today, the microcomputer's potential was just something you talked about.

Now, you can put it to work. Powerfully.

#### GENTLEMEN:

I'm power hungry!

- ☐ Send 65K RAM Board Kit \$2599 ☐ Assembled \$3899  
☐ Send 32K RAM Board Kit \$749 ☐ Assembled \$1099  
☐ Send 16K RAM Board Kit \$449 ☐ Assembled \$679  
☐ Send IMM ROM Control Kit \$299 ☐ Assembled \$399  
☐ Send IMM ERROM Control Kit \$499 ☐ Assembled \$699  
☐ Send full catalog \$1.00

Check/MO enclosed, Amt. \$ \_\_\_\_\_

Charge my: ☐ BAC ☐ M/C \_\_\_\_\_

# \_\_\_\_\_ Exp. Date: \_\_\_\_\_

Sig. \_\_\_\_\_

☐ Send name of my nearest IMSAI dealer

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State/Zip \_\_\_\_\_

## IMSAI®

IMSAI Manufacturing Corporation  
14860 Wicks Blvd.  
San Leandro, CA 94577  
(415) 483-2093 TWX 910-366-7287

# ULTRABYTE

★ PRESENTS ★

## THE FORMULA FOR POWER



+ Z-80  
CPU BOARD

= IMSAI<sup>TM</sup> Z-80

THAT'S RIGHT! THIS ULTRA-POWERFUL COMBINATION IS OFFERED BY ULTRABYTE,  
YOUR FACTORY AUTHORIZED DEALER OF ALL THESE QUALITY COMPONENTS

### PLEASE RUSH ME THE FOLLOWING:

- |                          |   |           |
|--------------------------|---|-----------|
| <input type="checkbox"/> | *IMSAI Z-80 Standard Kit, (without Standard CPU Board) with Powerful TDL ZPU Board .....  | \$ 794.00 |
| <input type="checkbox"/> | *Same as above (IMSAI plus Z-80), but with 22 Slot Mother Board .....   | \$ 839.00 |
| <input type="checkbox"/> | IMSAI 8080 Kit, Standard .....  | \$ 594.00 |
| <input type="checkbox"/> | IMSAI 8080 Kit, with 22 Slot Mother Board .....   | \$ 619.00 |
| <input type="checkbox"/> | Card Guides, 20 pairs .....   | \$ 20.00  |
| <input type="checkbox"/> | IMSAI 4K Bytes Static Memory, Kit .....   | \$ 129.00 |
| <input type="checkbox"/> | IMSAI Multiple I/O Board, Kit .....   | \$ 180.00 |
| <input type="checkbox"/> | TDL System Monitor Board .....  | \$ 275.00 |
| <input type="checkbox"/> | TDL 12K Memory, Kit .....   | \$ 392.00 |
| <input type="checkbox"/> | TDL 8K Expandable Memory .....  | \$ 279.00 |
| <input type="checkbox"/> | TDL 16K Memory .....  | \$ 549.00 |
| <input type="checkbox"/> | TDL 4K Expansion Kit .....  | \$ 135.00 |
| <input type="checkbox"/> | TDL ZPU Card .....  | \$ 242.00 |
| <input type="checkbox"/> | OAE Paper Tape Reader (OP-80A) .....  | \$ 75.50  |
| <input type="checkbox"/> | SEALS 8K Board .....  |           |
|                          | 500 ns Maximum .....  | \$ 255.00 |
|                          | 225 ns Maximum .....  | \$ 280.00 |
| <input type="checkbox"/> | ICOM's Microfloppy Disk System, Including Drive, Power Supply, Cabinet, Controller/Interface Card, Manuals, Diskette & Software ..... | \$ 995.00 |
| <input type="checkbox"/> | ICOM's Frugal Floppy, including Disk Drive, CF 360 Controller, all Cables and Connectors .....  | \$1129.00 |
| <input type="checkbox"/> | ICOM's Frugal Floppy, same as above, but with Dual Disk Drive .....   | \$1749.00 |
|                          | <b>SUB TOTAL</b> .....  |           |

PHONE (714) 892-4679

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

\*PHONE IN YOUR CREDIT CARD ORDERS  
\*CALIF. RES. ADD 6% SALES TAX  
\*MOST ORDERS SHIPPED WITHIN 30 DAYS  
\*SHIPPING CHARGE: COLLECT F.O.B. FACTORY

Enclosed Check or Money Order  
For \$ \_\_\_\_\_

BankAmericard No. \_\_\_\_\_

Mastercharge No. \_\_\_\_\_

Interbank No. \_\_\_\_\_

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

UltraByte Incorporated

SEND MAIL TO:  
P.O. Box 370, Westminster, CA. 92683  
(714) 892-4679

Executive Offices:  
Park Plaza Building, Suite 8  
7281 Plaza Street, Westminster, CA. 92683  
(Send Self-addressed, stamped envelope for complete computer accessory list)